Chapter 5

Toxic Air Contaminant Emissions, Air Quality, and Health Risk

Introduction

This chapter presents a summary of the emissions and air quality data available for selected toxic air contaminants, or TACs. The Health and Safety Code defines a TAC as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health. There are almost 200 compounds that have been designated as TACs in California. Some of these TACs are groups of compounds which contain many individual substances (e.g., copper compounds, polycyclic aromatic compounds). The summary information includes available data for the ten TACs posing the greatest known health risk in California, based primarily on ambient air quality data. These TACs are acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter (diesel PM). Besides the ten selected TACs, dioxins are also considered to pose substantial health risk, and a brief discussion on dioxins is presented in this introduction.

Chapter 5 is organized in three major sections. The introduction provides an overview of emission and air quality information on TACs. The second section provides summaries of statewide emissions, annual average concentrations (calculated as an average of the monthly means), and estimated health risks for the ten selected TACs. The third section provides similar information for California's five most populous air basins: the South Coast, the San Francisco Bay Area, the San Joaquin Valley, the San Diego, and the Sacramento Valley air basins. Tables of concentration and health risk data for the ten TACs at the state, air basin, and site levels are presented in Appendix C.

It is important to note that the summarized data reflect a spatial average, and ambient concentrations and health risks for individual locations may be higher or lower. In addition, the information presented here reflect the ten TACs that pose the most substantial health risk, based on data collected only at sites operated by the ARB. There may be other TACs that pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern. Additional information on interpreting air quality data for TACs can be found in Chapter 1.

Sources of Toxic Air Contaminant Emissions in California. Similar to the criteria pollutants, TACs are emitted from stationary sources, area-wide sources, and mobile sources. The stationary source emissions inventory was developed by the ARB in cooperation with affected industries and the air pollution control and air quality management districts (districts) as part of AB 2588, the Air Toxics Hot Spots Information and Assessment Act of 1987 (Hot Spots Program). The ARB developed the emission estimates for area-wide sources and mobile sources.

Emissions of the selected TACs are reported on a statewide basis and for the ten highest-emitting counties in California. Emissions are also included for the five most populous air basins. In general, the inventory base year is 2006. Note, however, that the stationary source emissions inventory uses the best available information for the emission source, although the data may not have been specifically collected for 2006.

Air Quality Monitoring for Toxic Air Contaminants. The ARB maintains a statewide air quality monitoring network for TACs. The network was originally designed to measure selected substances in the ambient air to determine if levels were sufficiently high to be of concern. As a result of this monitoring, the ARB has determined atmospheric concentrations for over 60 individual substances. As shown in Figure 5-1, the ARB currently maintains a network of 17 air quality monitoring stations, measuring ambient concentrations of 64 substances.

TAC samples are generally collected once every 12 days, throughout the year. This results in 20,000 to 35,000 individual TAC measurements annually. The TAC data are typically sampled, analyzed, and reported as 24-hour averages. These 24-hour averages provide the basis for the annual average concentrations. The annual average concentrations are then used to support statewide risk assessment.

The TAC air quality trends included in this chapter are based on ambient data collected during 1990 through 2005 except for diesel PM which currently has no widely accepted monitoring method. The ARB has made some estimates of ambient diesel PM concentrations in 1998 based on receptor modeling techniques. These estimates are currently being reviewed to reflect control measures that are outlined in the Diesel Reduction Plan.

To minimize the influences of extreme weather on the trends, three-year statewide average concentrations were used to assess changes in individual TACs over time. The trend is determined by comparing the resulting averages from the beginning and end of the monitoring periods. For about half of the ten TACs, the baseline average concentration is for 1990-1992, and the current average concentration is for 2003-2005. However, acetaldehyde and formaldehyde data collected prior to 1996 are underestimated, so their respective baseline average concentration is for 1996-1998. For hexavalent chromium and *para*-dichlorobenzene, monitoring data were available starting in 1992 and 1991, respectively, so their baseline averages are for 1992-1994 and 1991-1993. Carbon tetrachloride data from February 2004 though 2005 are not available because of a problem with the laboratory standard. Therefore, carbon tetrachloride's baseline average is for 1990-1991 (1992 average was invalid), and the current average concentration is for 2001-2003.

Statewide Health Risk and Community Health. In the Almanac, health risk is presented on a pollutant-by-pollutant basis as well as on a cumulative basis with a focus on cancer risk. The risk for an individual TAC is calculated by multiplying its unit risk factor with its annual average concentration. The unit risk factor is expressed as the probability, or risk, of contracting cancer as a result of constant exposure to an ambient concentration of one microgram per cubic meter for 70 years. It reflects only the inhalation pathway. The risk is expressed as the risk of contracting cancer (or excess cancer cases)

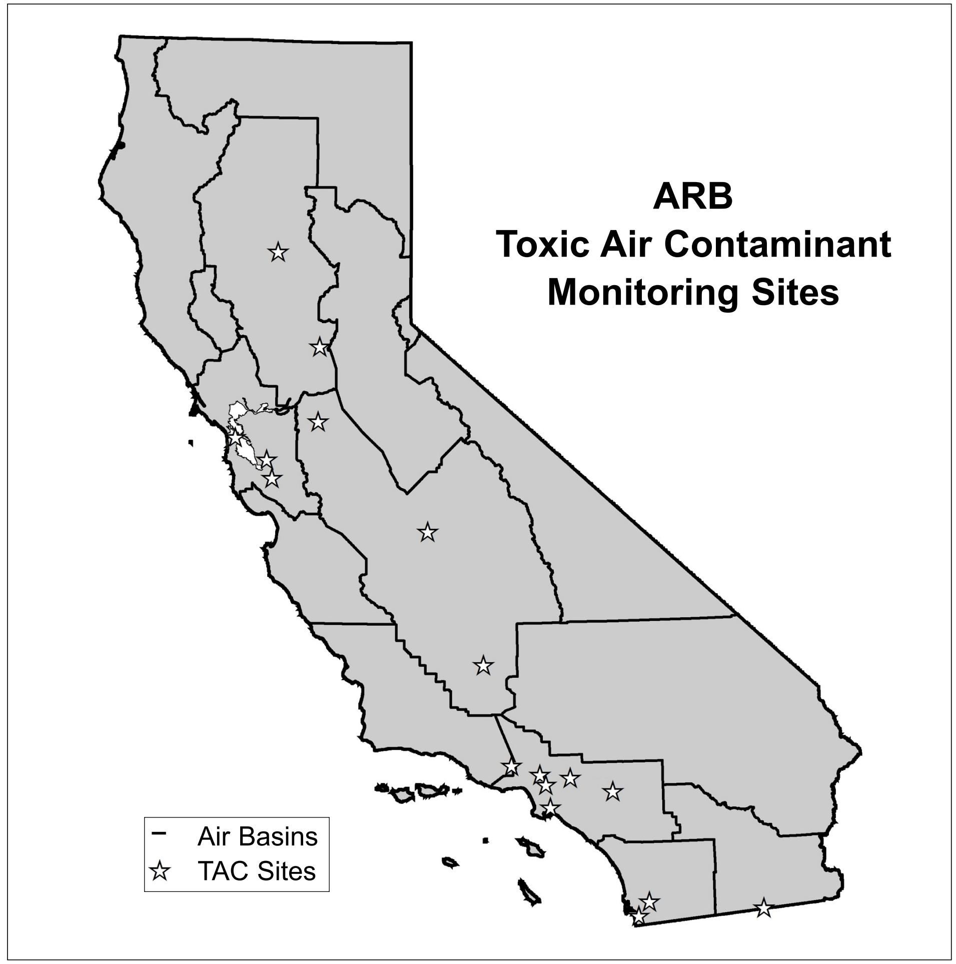


Figure 5-1

per million people exposed over a 70-year period. Table 5-1 lists the unit risk factor and limit of detection (LOD) for each of the ten TACs presented in this almanac. The LOD is the lowest concentration of a substance that can be reliably measured, and measurements below the LOD are assumed to be one-half of the LOD.

The TAC monitoring network is designed to provide air quality data in support of general population exposures. Therefore, the data do not provide information on localized impacts, often referred to as near-source or neighborhood exposures. Localized impacts may involve exposure to different TACs with higher or lower concentrations than those represented by the ambient air monitoring data.

The ARB participated in several studies to address localized impacts and community health issues. For example, during October 1999, ARB initiated a monitoring and evaluation study in the Barrio Logan and Logan Heights neighborhoods of San Diego. In addition, ARB has conducted monitoring in five other communities in support of the community health program as required by the Children's Environmental Health Protection Program (SB 25). Efforts such as these will supplement our existing statewide TAC monitoring network, which was designed for regional rather than neighborhood assessments. Information on these and other studies is available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

Monitoring for Dioxins. Dioxins and furans, collectively referred to as dioxins, are a group of chemicals with similar structures and chemical properties. When found in the environment, dioxins are usually a mixture of these chemicals. Dioxins are byproducts of various industrial and combustion activities, and they can be emitted from vehicles, waste incineration, chemical manufacturing plants, and forest fires. Once released into the environment, dioxins are highly persistent and can accumulate in the tissues of animals and humans.

Dioxins enter the body through direct inhalation or can accumulate in the body from eating dioxins-contaminated vegetation or animals that have eaten such vegetation. Many studies have shown that dioxins can cause cancer and other health problems including birth defects and liver damage.

The ARB has identified dioxins as a TAC, and the U.S. EPA has listed them as hazardous air pollutants. In 1990, the ARB adopted a control measure to reduce emissions of dioxins from medical waste incinerators by 99 percent. At the time, medical waste incinerators were one of the largest known air sources of dioxins in California. As a result of the control measure, the number of medical incinerators in the State dropped sharply, from about 150 to less than 10.

Toxic Air Contaminant Unit Risk Factors

Toxic Air Contaminant	Unit Risk/Million People[1]	Detection Limit (ppb)
Acetaldehyde	2.7	0.10
Benzene	29	0.05
1,3-Butadiene	170	0.04
Carbon Tetrachloride	42	0.02
Chromium, Hexavalent	150,000	0.06[2]
para-Dichlorobenzene	11	0.30
Formaldehyde	6	0.10
Methylene Chloride	1	0.10
Perchloroethylene	5.9	0.01
Diesel Particulate Matter	300[3]	N/A

1 The unit risk represents the number of excess cancer cases per million people per microgram per cubic meter TAC concentration over a 70-year, lifetime exposure.
2 The hexavalent chromium detection limit units are in nanograms per cubic meter.
3 A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the *"Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles"* (ARB, October 2000).

Table 5-1

In order to provide information on ambient levels of dioxins and dioxin-like compounds, the ARB has developed the California Ambient Dioxin Air Monitoring Program (CADAMP). This program is modeled, in part, after the U.S. EPA's National Dioxin Air Monitoring Network (NDAMN) to ensure the data from the two networks can be used interchangeably. The two networks use the same sampling and analytical techniques; however, CADAMP focuses on dioxins sampling in urban areas while NDAMN emphasizes rural areas nationwide. Ten sampling sites were deployed in CADAMP, five in the San Francisco Bay Area, four in the South Coast Air Basin, and one in Sacramento. Several of the CADAMP sites are also part of the ARB's Children's Environmental Health Protection Program (SB 25). The monitoring period was from December 2001 to August 2006. The dioxin monitoring data can be found at *www.arb.ca.gov/pub/dioxin/cadamp.php*. General information on ARB's dioxins program is available at *www.arb.ca.gov/toxics/dioxins/dioxins.htm*.

Statewide TAC Emissions and Ambient Health Risks. Table 5-2 provides a summary of the Statewide emissions for the top 10 toxics. Figure 5-2 provides a graphical presentation of the Statewide ambient health risks for 2005. Data for Diesel PM reflect 2000 and carbon tetrachloride reflect 2003.

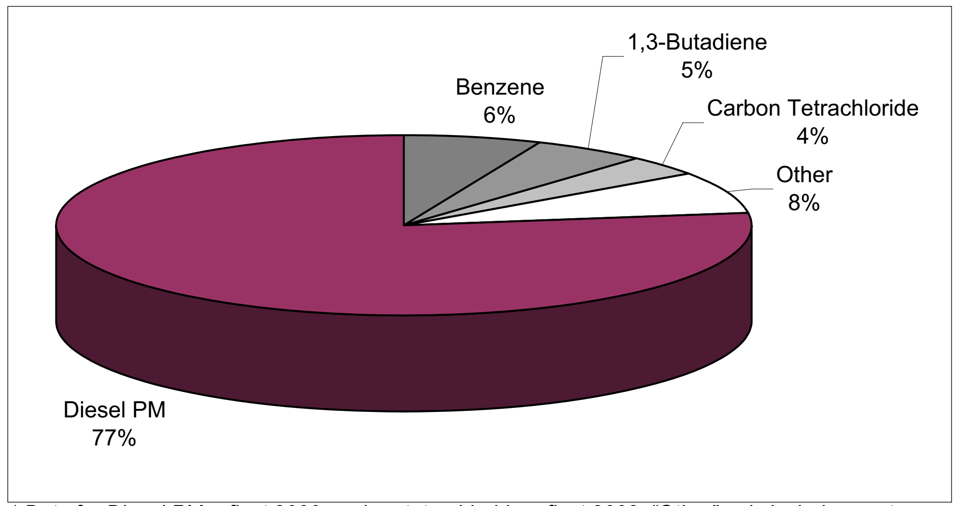
Additional Information. Additional emissions and air quality data for the ten TACs in this almanac, as well as many other TACs, may be found by accessing the ARB website at *www.arb.ca.gov/html/aqe&m.htm*. The web data are updated periodically, as new information becomes available. More detailed information on the health effects of these compounds, as well as other TACs, can be found in an ARB report entitled: *"Update to the Toxic Air Contaminant List"* dated December 1999. This report can be obtained by accessing the ARB website at *www.arb.ca.gov/toxics/id/id.htm*.

2006 Statewide TAC Emissions

TAC	tons/year
Acetaldehyde	10,023
Benzene	12,060
1,3-Butadiene	3,589
Carbon Tetrachloride	2
Chromium, Hexavalent	1
para-Dichlorobenzene	1,469
Formaldehyde	23,154
Methylene Chloride	6,527
Perchloroethylene	4,865
Diesel PM	42,326

Table 5-2

2005 Statewide Health Risks[1]



[1] Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; "Other" only includes acetaldehyde, formaldehyde, para-dichlorobenzene, hexavalent chromium, perchloroethylene, and methylene chloride.

Figure 5-2

Acetaldehyde

2006 Statewide Emission Inventory

Acetaldehyde is a federal hazardous air pollutant (HAP). The ARB identified acetaldehyde as a TAC in April 1993 under AB 2728. This bill required the ARB to identify all federal HAPs as TACs. In California, acetaldehyde is identified as a carcinogen. This compound also causes chronic non-cancer toxicity in the respiratory system.

Acetaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Sources of acetaldehyde include emissions from combustion processes such as exhaust from mobile sources and fuel combustion from stationary internal combustion engines, boilers, and process heaters. In California, photochemical oxidation is the largest source of acetaldehyde concentrations in the ambient air. Approximately 32 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 50 percent attributed to other mobile sources such as construction and mining equipment, aircraft, recreational boats, and agricultural equipment. Area-wide sources of emissions, which contribute 16 percent of the statewide acetaldehyde emissions, include the burning of wood in residential fireplaces and wood stoves. Stationary sources contribute two percent of the statewide acetaldehyde emissions. The primary stationary sources are from fuel combustion from the petroleum industry.

Acetaldehyde		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	163	2%
Area-wide Sources	1653	16%
On-Road Mobile	3159	32%
Gasoline Vehicles	919	9%
Diesel Vehicles	2240	22%
Other Mobile	5049	50%
Gasoline Fuel	911	9%
Diesel Fuel	3534	35%
Other Fuel	604	6%
Natural Sources	0	0%
Total Statewide	***10023***	***100%***

Table 5-3

2006 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 47 percent of the statewide acetaldehyde emissions. The South Coast Air Basin has three of the top ten counties: South Coast portion of Los Angeles County (13 percent of the emissions of acetaldehyde statewide), Orange County (four percent), and South Coast portion of San Bernardino County (three percent). Collectively, approximately 23 percent of statewide acetaldehyde emissions occur in the South Coast Air Basin. San Diego County accounts for approximately six percent. The six other counties in the top ten for acetaldehyde emissions are: Kern (San Joaquin Valley portion), San Bernardino (Mojave Desert portion), Alameda, Fresno, Santa Clara, and San Joaquin. These six counties account for approximately 17 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1343	13%
San Diego	San Diego	589	6%
Orange	South Coast	420	4%
Kern	San Joaquin Valley	393	4%
San Bernardino	Mojave Desert	387	4%
Alameda	San Francisco Bay Area	381	4%
Fresno	San Joaquin Valley	351	3%
Santa Clara	San Francisco Bay Area	298	3%
San Bernardino	South Coast	290	3%
San Joaquin	San Joaquin Valley	286	3%

Table 5-4

Acetaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of acetaldehyde in its statewide air toxics monitoring network. Figure 5-3 presents a trend graph of acetaldehyde for the years 1990 through 2005. The graph shows a general decrease in acetaldehyde levels from 1990-1997 with some year-to-year fluctuations. There was a sharp drop in acetaldehyde levels during 1995 and a corresponding increase the following year. Levels between 1997 and 2005 have shown little variation.

Although concentration and health risk data are available from 1990 to 2005, the data prior to 1996 are lower than expected because the ARB collected ambient samples using a method that underestimated the actual concentrations. A method change in 1996 corrected this bias; however, the ARB was unable to develop a correction factor for the earlier data. The data prior to 1996 are included here because it is certain that at least the reported amount was present. However, the data prior to 1996 are not directly comparable to data collected during the later years.

The acetaldehyde trend is based on monitoring data. To minimize the influences of weather on the trend, three-year average statewide concentrations are used to assess the change over time. To do this, the resulting averages at the beginning and the end of the monitoring period were compared. Although acetaldehyde data were collected beginning in 1990, as noted above, data prior to 1996 were unreliable. Therefore, the period 1996-1998 was used as the baseline average for comparison to 2003-2005. The result shows a one percent increase in acetaldehyde concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2005, there were an estimated six excess cancer cases per million people due to acetaldehyde. On an individual basis, the health risks from acetaldehyde are much lower than they are for some of the other TACs. Among the ten compounds presented in this almanac, the health risk from acetaldehyde ranks eighth.

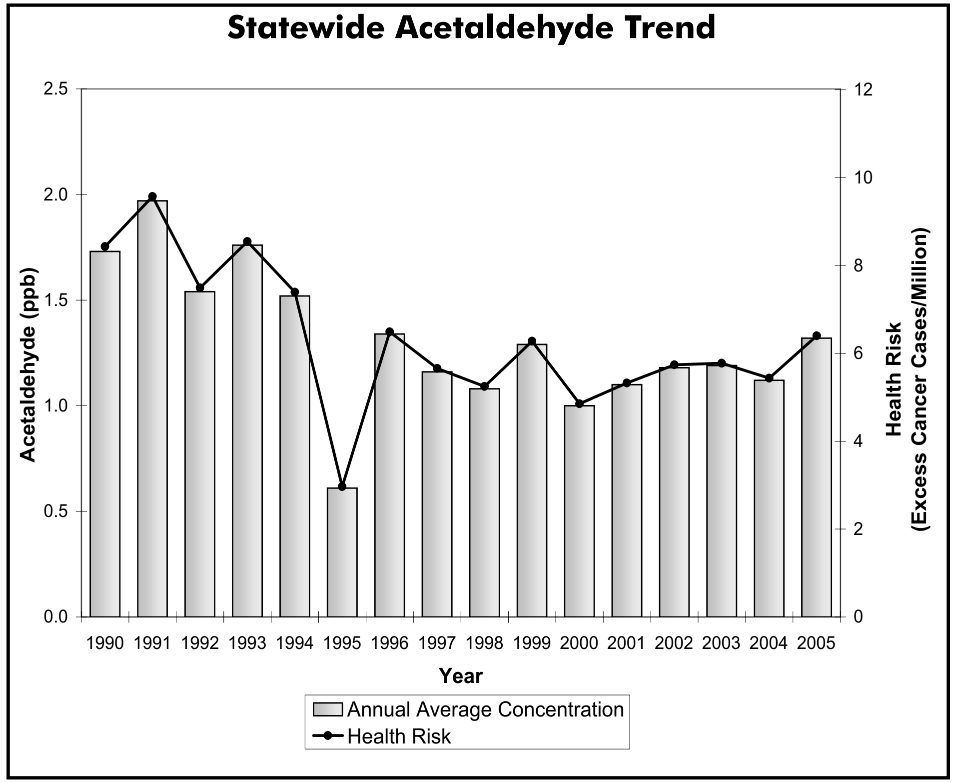


Figure 5-3

It is important to note that the health risk due to acetaldehyde is not spread evenly throughout the State. This is common for almost all pollutants. The data reflect statewide averages, and do not consider local impacts. Therefore, some Californians may be exposed to near-source, or “hot spot” concentrations of acetaldehyde which are above the statewide annual average concentration. “Hot spot” exposure may increase the potential cancer risk to individuals living near large combustion sources. Information collected under AB 2588 (the Hot Spots Program) will be used to help determine the priority and need for control of sources of acetaldehyde.

Another factor to consider is that the statewide averages reflect ambient outdoor concentrations. In general, acetaldehyde concentrations are higher indoors than outdoors, due in part to the abundance of combustion sources, such as cigarettes, fireplaces, and woodstoves.

Acetaldehyde is directly emitted from combustion sources and also occurs in the environment as a result of the photochemical oxidation of ROG. Over the years, stringent emission standards for new vehicles have resulted in steady declines in directly emitted acetaldehyde due to vehicular emissions. However, its secondary formation can be hard to quantify, and can contribute to fluctuations in ambient levels of acetaldehyde.

Benzene

2006 Statewide Emission Inventory

Benzene is highly carcinogenic and occurs throughout California. The ARB identified benzene as a TAC in January 1985 under California's TAC program (AB 1807). In addition to being a carcinogen, benzene also has non-cancer health impacts. Brief inhalation exposure to high concentrations can cause central nervous system depression. Acute effects include central nervous system symptoms of nausea, tremors, drowsiness, dizziness, headache, intoxication, and unconsciousness.

Current estimates show that approximately 88 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust. The predominant sources of total benzene emissions in the atmosphere are gasoline fugitive emissions and gasoline motor vehicle exhaust. Approximately 50 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 38 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gasoline is less than one percent. Some of the benzene in the fuel is emitted from vehicles as unburned fuel. Benzene is also formed as a partial combustion product of larger aromatic fuel components. Industry-related stationary sources contribute ten percent and area-wide sources contribute one percent of the statewide benzene emissions. The primary stationary sources of reported benzene emissions are crude petroleum and natural gas mining, petroleum refining, and electric generation. The primary area-wide sources include residential combustion of various types such as cooking and water heating. The primary natural sources are petroleum seeps that form where oil or natural gas emerge from subsurface sources to the ground or water surface.

Benzene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1231	10%
Area-wide Sources	122	1%
On-Road Mobile	6036	50%
Gasoline Vehicles	5426	45%
Diesel Vehicles	609	5%
Other Mobile	4625	38%
Gasoline Fuel	3360	28%
Diesel Fuel	962	8%
Other Fuel	304	3%
Natural Sources	46	0%
Total Statewide	***12060***	***100%***

Table 5-5

2006 Top Ten Counties - Benzene

The top ten counties account for approximately 51 percent of the statewide benzene emissions. The South Coast Air Basin has four of the top ten counties emitting benzene, representing 30 percent of statewide benzene emissions. San Diego contributes seven percent. Two counties in the San Francisco Air Basin contribute approximately seven percent: Santa Clara County (three percent) and Alameda County (three percent). The three other counties in the top ten for benzene emissions are: Kern (San Joaquin portion), San Bernardino (Mojave Desert portion), and Sacramento. These counties account for approximately 12 percent of statewide benzene emissions.

Benzene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2143	18%
San Diego	San Diego	869	7%
Orange	South Coast	683	6%
Kern	San Joaquin Valley	655	5%
San Bernardino	Mojave Desert	425	4%
San Bernardino	South Coast	400	3%
Santa Clara	San Francisco Bay Area	395	3%
Alameda	San Francisco Bay Area	389	3%
Riverside	South Coast	353	3%
Sacramento	Sacramento Valley	325	3%

Table 5-6

Benzene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of benzene in its statewide air toxics monitoring network. Figure 5-4 shows the annual average statewide benzene concentrations and the associated health risk from benzene alone. Ambient levels have shown generally steady improvement since 1990. To examine the trend in benzene while minimizing the influences of weather on the trend, the statewide average benzene concentration for 1990-1992 was compared to that for 2003-2005. The result is a 77 percent decrease in both concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration level over a 70-year lifetime. From these data, it is apparent that benzene poses a substantial health risk. Based on the statewide averages, benzene ranks second highest among the ten TACs presented in this almanac. During 2005, there was an estimated risk of 44 excess cancer cases per million people due to benzene. However, as with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower. In general, ambient benzene concentrations and associated health risks tend to be higher in the more urbanized areas.

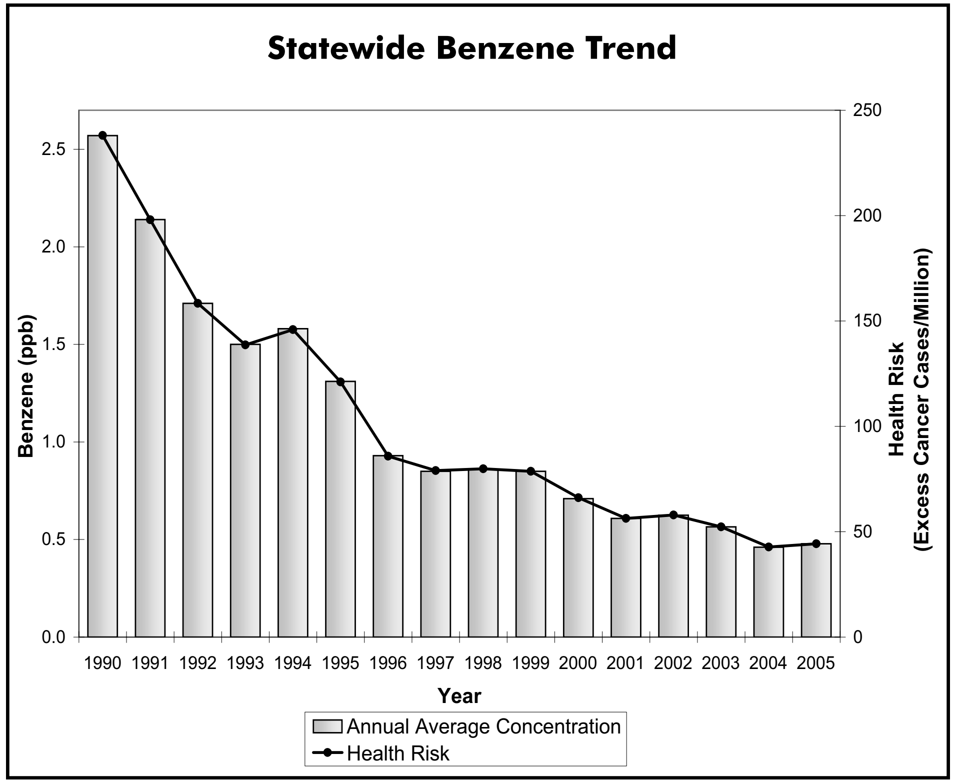


Figure 5-4

It is important to note that the ambient benzene concentrations have been corrected to provide a consistent long-term data record. Prior to 1999, the ARB analyzed samples using a single-point calibration of the gas chromatograph analyzers. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient benzene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year long study showed that the two measurement methods were highly correlated, and the ARB was able to develop a predictive relationship between the two. To avoid discontinuity in the trend data, the pre-1999 benzene data shown in Figure 5-4 have been adjusted according to these predictive equations, and they now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the "Laboratory Standard Operating Procedures for Ambient Air" page on the ARB website at *www.arb.ca.gov/aaqm/sop/summary/summary.htm.*

The ARB started to use a gas chromatography/mass spectrometry (GC/MS) based method to analyze benzene in 2001 to fulfill a lower detection limit requirement for the SB25 and Neighborhood Assessment Programs. The new method is also in line with the new U.S. EPA Urban Air Toxic Program being developed nationally. Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

Although the health risk from benzene is still substantial, emissions have been reduced significantly over the last decade, and will be reduced further in California through a progression of regulatory measures and control technologies. The LEV regulations have resulted in a significant reduction in exhaust and evaporative hydrocarbon emissions, including benzene. As the fleet turns over and new LEV technology vehicles are introduced into the fleet, emission reductions will continue. In 1996, the California Phase II Reformulated Gasoline Program was implemented statewide. Fuel reformulation has led to a substantial decrease in the level of benzene from gasoline and vehicle exhaust emissions. Since motor vehicles continue to be the major source of benzene in the State, future efforts to improve fuel formulations, reduce vehicle exhaust emissions, and promote less polluting modes of transportation will likely continue to help reduce benzene emissions.

1,3-Butadiene

2006 Statewide Emission Inventory

The ARB identified 1,3-butadiene as a TAC in 1992. In California, 1,3-butadiene has been identified as a carcinogen. In addition, 1,3-butadiene vapors are mildly irritating to the eyes and mucous membranes and cause neurological effects at very high levels.

Most of the emissions of 1,3-butadiene are from incomplete combustion of gasoline and diesel fuels. Mobile sources account for approximately 64 percent of the total statewide emissions. Vehicles that are not equipped with functioning exhaust catalysts emit greater amounts of 1,3-butadiene than vehicles with functioning catalysts. Approximately 34 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 30 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and aircraft. Area-wide sources such as agricultural waste burning and open burning associated with forest management contribute approximately ten percent. Stationary sources contribute less than one percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions include petroleum refining, manufacturing of synthetics and man-made materials, and oil and gas extraction. The primary natural sources of 1,3-butadiene emissions are wildfires.

1,3-Butadiene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	15	0%
Area-wide Sources	358	10%
On-Road Mobile	1209	34%
Gasoline Vehicles	1151	32%
Diesel Vehicles	58	2%
Other Mobile	1070	30%
Gasoline Fuel	774	22%
Diesel Fuel	91	3%
Other Fuel	205	6%
Natural Sources	937	26%
Total Statewide	***3589***	***100%***

Table 5-7

2006 Top Ten Counties - 1,3-Butadiene Emissions

The top ten counties account for approximately 44 percent of the statewide 1,3-butadiene emissions. Emission sources in the South Coast Air Basin contribute approximately 19 percent of the statewide total: Los Angeles County (12 percent), Orange County (four percent), and South Coast portion of San Bernardino County (three percent). San Diego County accounts for approximately seven percent. Two counties in the San Joaquin Valley Air Basin contribute seven percent of the 1,3-butadiene: Tulare County (four percent) and Fresno County (three percent). The other counties in the top ten account for 11 percent: San Bernardino (Mojave Desert portion), Tuolumne, Siskiyou and Trinity.

1,3-Butadiene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	437	12%
San Diego	San Diego	241	7%
Tulare	San Joaquin Valley	156	4%
Orange	South Coast	135	4%
San Bernardino	South Coast	110	3%
San Bernardino	Mojave Desert	109	3%
Fresno	San Joaquin Valley	108	3%
Tuolumne	Mountain Counties	99	3%
Siskiyou	Northeast Plateau	98	3%
Trinity	North Coast	87	2%

Table 5-8

1,3-Butadiene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of 1,3-butadiene in its statewide air toxics monitoring network. Figure 5-5 shows the annual average statewide 1,3-butadiene concentrations and the associated health risk from this TAC alone since 1990. The data show a general downward trend, with some variability. To examine the trend in 1,3-butadiene while minimizing the influences of weather, the statewide average 1,3-butadiene concentration for 1990-1992 was compared to that for 2003-2005. The result is a 70 percent decrease in both concentration and health risk. Despite this substantial drop, the health risk from this compound remains relatively high. In 2005, there was an estimated risk of 38 excess cancer cases per million people. Of the ten compounds presented in this almanac, the average statewide health risk from 1,3-butadiene ranks third. Again, it is important to note that the data shown here reflect statewide averages. They do not consider local impacts, which may be higher or lower.

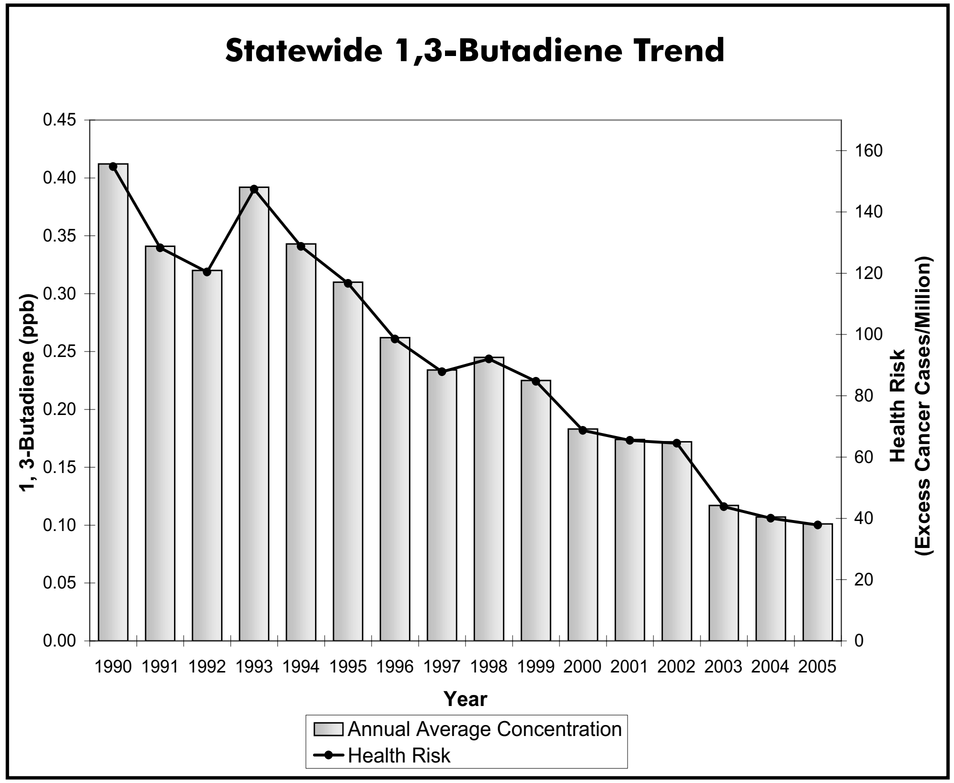


Figure 5-5

Similar to benzene, the ARB analyzed 1,3-butadiene samples using a single-point calibration of the gas chromatograph analyzers prior to 1999. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient 1,3-butadiene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year-long ARB study showed that the two measurement methods were highly correlated, and the ARB was able to develop a predictive relationship between them. To avoid discontinuity in the trend data, the pre-1999 1,3-butadiene data shown in Figure 5-5 have been adjusted according to these predictive equations and now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the "Laboratory Standard Operating Procedures for Ambient Air" page on the ARB website at *www.arb.ca.gov/aaqm/sop/summary/summary.htm*.

Similar to benzene, the ARB started to use a GC/MS based method to analyze 1,3-butadiene in 2001. This change in method fulfilled a lower detection limit requirement for the SB 25 and Neighborhood Assessment Programs. The new method is also in line with the new U.S. EPA Urban Air Toxic Program being developed nationally.

Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

In California, the majority of 1,3-butadiene emissions are from incomplete combustion of gasoline and diesel fuels. The ARB adopted LEV/Clean Fuels regulations in 1990 and the Phase II reformulated gasoline regulations were implemented in 1996. The LEV regulations are expected to continue to reduce 1,3-butadiene emissions from cars and light-duty trucks as the fleet turns over and new LEVs are introduced into the fleet.

Carbon Tetrachloride

2006 Statewide Emission Inventory

The ARB identified carbon tetrachloride as a TAC in 1987 under California's TAC program (AB 1807). In California, carbon tetrachloride has been identified as a carcinogen. Carbon tetrachloride is also a central nervous system depressant and mild eye and respiratory tract irritant.

The primary stationary sources reporting emissions of carbon tetrachloride include chemical and allied product manufacturers and petroleum refineries. In the past, carbon tetrachloride was used for dry cleaning and as a grain-fumigant. Usage for these purposes is no longer allowed in the United States. Carbon tetrachloride has not been registered for pesticidal use in California since 1987. Also, the use of carbon tetrachloride in products to be used indoors has been discontinued in the United States. The statewide emissions of carbon tetrachloride are small (about 1.96 tons per year), and background concentrations account for most of the health risk.

Carbon Tetrachloride		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1.96	100%
Area-wide Sources	0	0%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***1.96***	***100%***

Table 5-9

2006 Top Ten Counties - Carbon Tetrachloride

The top two counties account for 75 percent of the statewide carbon tetrachloride emissions. Contra Costa County (San Francisco Bay Area Air Basin) accounts for approximately 47 percent, and Orange County accounts for approximately 28 percent of the emissions of carbon tetrachloride statewide. Although the percentages for these counties are high, the emissions are very small (one ton or less per year in each county). The eight other counties in the top ten contribute approximately 25 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	**Air Basin**	**tons/year**	**Percent**
Contra Costa	San Francisco Bay Area	1	47%
Orange	South Coast	1	28%
San Diego	San Diego	<1	5%
Riverside	South Coast	<1	4%
Los Angeles	South Coast	<1	4%
San Bernardino	South Coast	<1	3%
Ventura	South Central Coast	<1	3%
Sacramento	Sacramento Valley	<1	3%
San Bernardino	Mojave Desert	<1	2%
Kern	Mojave Desert	<1	1%

Table 5-10

Carbon Tetrachloride

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of carbon tetrachloride in its statewide air toxics monitoring network. Figure 5-6 shows the annual average statewide concentrations and the associated health risk from carbon tetrachloride alone. As with a number of other TACs, there are several years of incomplete data for carbon tetrachloride. The annual average concentration is available only if there is a full year of data. Based on the available data, the ambient concentrations and health risk dropped between 1990 and 1996, and then there was a substantial increase in values for 1998, followed by levels which stayed fairly constant between 2000 and 2003. Carbon tetrachloride data from February 2004 through 2005 are not available because of a problem with the laboratory standard.

To examine the trend in carbon tetrachloride while minimizing the influences of weather on the trend, the statewide average carbon tetrachloride concentration for 1990-1991 (1992 average was invalid) was compared to that for 2001-2003. The result is a 30 percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. In 2003, there was an estimated risk of 25 excess cancer cases per million people. The health risk of this TAC ranks fourth among the ten compounds presented in this almanac. As with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower.

Unlike many of the other TACs, carbon tetrachloride is emitted primarily by sources other than motor vehicles, and there are virtually no emissions within California. However, because carbon tetrachloride persists in the atmosphere for many years (the estimated atmospheric lifetime is 50 years), background concentrations still pose a health risk.

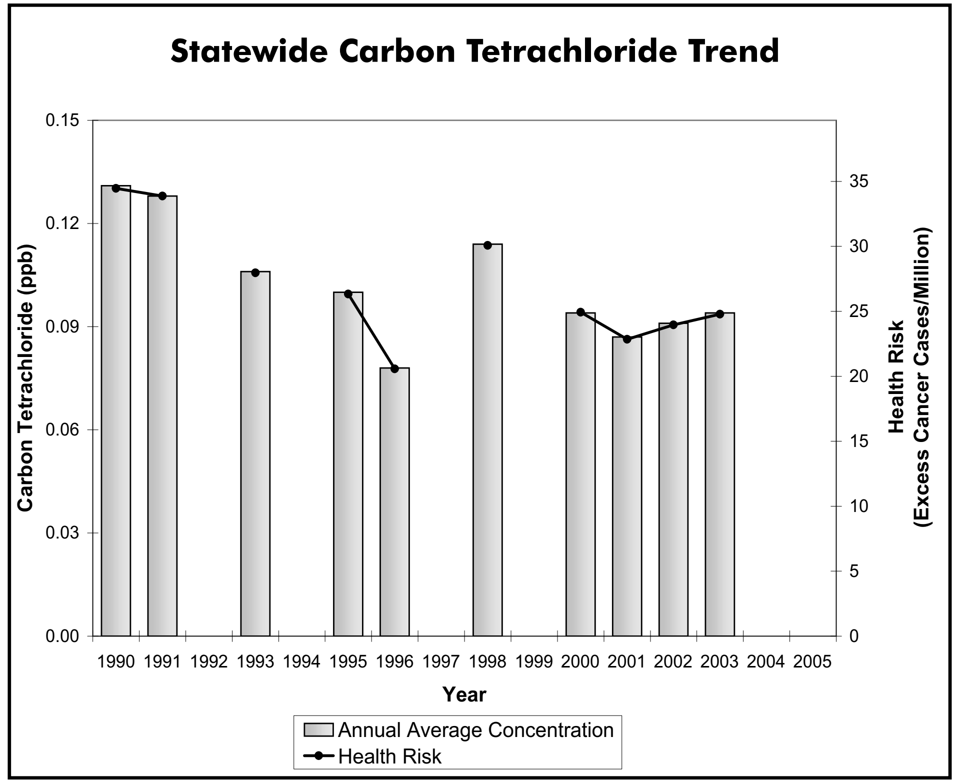


Figure 5-6

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Chromium, Hexavalent

2006 Statewide Emission Inventory

Hexavalent chromium was identified as a TAC in 1986 under California's TAC program (AB 1807, Tanner, 1983). In California, hexavalent chromium has been identified as a carcinogen. There is epidemiological evidence that exposure to inhaled hexavalent chromium may result in lung cancer. The principal acute effects of hexavalent chromium are renal toxicity, gastrointestinal hemorrhage, and intravascular hemolysis.

Chrome plating is no longer the primary source of hexavalent chromium emissions in the State. Hexavalent chromium emissions from plating have declined significantly from previous editions of the almanac due to many platers switching to the use of trivalent chromium in place of hexavalent chromium. Chromic acid anodizing is another industrial metal finishing process which uses hexavalent chromium. A third source of hexavalent chromium emissions is the firebrick lining of glass furnaces. In California, stationary sources are estimated to emit about 0.22 ton per year of hexavalent chromium. Emissions from these sources were obtained from facilities under the Air Toxics Hot Spots Act of 1987. This act required facilities to estimate toxics emissions, including hexavalent chromium. Approximately 0.15 tons of hexavalent chromium are emitted by gasoline motor vehicles. Other mobile sources such as trains and ships contribute approximately 0.77 tons of hexavalent chromium annually.

Chromium, Hexavalent		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	0.22	19%
Area-wide Sources	0.01	1%
On-Road Mobile	0.16	14%
Gasoline Vehicles	0.15	13%
Diesel Vehicles	< .01	1%
Other Mobile	0.77	67%
Gasoline Fuel	< .01	0%
Diesel Fuel	< .01	0%
Other Fuel	0.77	67%
Natural Sources	0	0%
Total Statewide	***1.16***	***100%***

Table 5-11

2006 Top Ten Counties - Chromium, Hexavalent

Four counties account for approximately 61 percent of the statewide hexavalent chromium emissions: Mojave Desert portion of Kern County (25 percent), San Diego County (20 percent), Kings (11 percent), and South Coast portion of Los Angeles (six percent). The six other counties in the top ten for hexavalent chromium emissions are: Imperial, Fresno, Los Angeles (Mojave Desert portion), Ventura, Kern (San Joaquin Valley portion), and Solano (San Francisco Bay Area portion). These six counties account for approximately 17 percent of statewide hexavalent chromium emissions.

Chromium, Hexavalent			
County	**Air Basin**	**tons/year**	**Percent**
Kern	Mojave Desert	0.29	25%
San Diego	San Diego	0.23	20%
Kings	San Joaquin Valley	0.12	11%
Los Angeles	South Coast	0.07	6%
Imperial	Salton Sea	0.06	5%
Fresno	San Joaquin Valley	0.04	4%
Los Angeles	Mojave Desert	0.03	3%
Ventura	South Central Coast	0.03	2%
Kern	San Joaquin Valley	0.02	2%
Solano	San Francisco Bay Area	0.02	2%

Table 5-12

Chromium, Hexavalent

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of hexavalent chromium in its statewide air toxics monitoring network. Chromium exists primarily in hexavalent and trivalent forms. Hexavalent chromium has been identified as a TAC and has been found to be much more reactive and much more toxic than trivalent chromium.

Fuel combustion from mobile sources is the largest source of hexavalent chromium emissions. Combustion from stationary sources is also a large source of emissions. Examples of other sources of hexavalent chromium emissions include chrome plating, chromic acid anodizing, and thermal spraying. In the past, compounds containing hexavalent chromium, such as sodium dichromate or lead chromate, were added to cooling tower water to control corrosion in the towers and associated heat exchangers. Hexavalent chromium was also used in motor vehicle and mobile equipment coatings.

ARB has adopted several control measures to reduce emissions or prohibit use of this very potent TAC. In 1988 ARB adopted the Chrome Plating Airborne Toxics Control Measure (ATCM). This ATCM reduced hexavalent chromium emissions from chrome plating and chromic acid anodizing operations by well over 90 percent, with the largest facilities reducing emissions by over 99 percent. This ATCM was amended in 2006 to further reduce emissions from all chrome plating and anodizing operations. In 1989, ARB adopted a measure that prohibited the use of hexavalent chromium compounds in cooling towers. ARB has also adopted a measure to prohibit use of hexavalent chromium in motor vehicle and mobile equipment coatings, and a measure that substantially reduces hexavalent chromium emissions from thermal spraying operations.

Statewide annual averages and health risk estimates for hexavalent chromium are available for 1992 through 2005. Prior to 1992, a different measurement method was used. With this method, some of the hexavalent chromium was transformed into trivalent chromium on the collection filter. As a result, the hexavalent chromium concentrations were unreliable, and these data are not included in this almanac. Since 1992, the method to analyze hexavalent chromium has been improved to prevent the transformation from occurring.

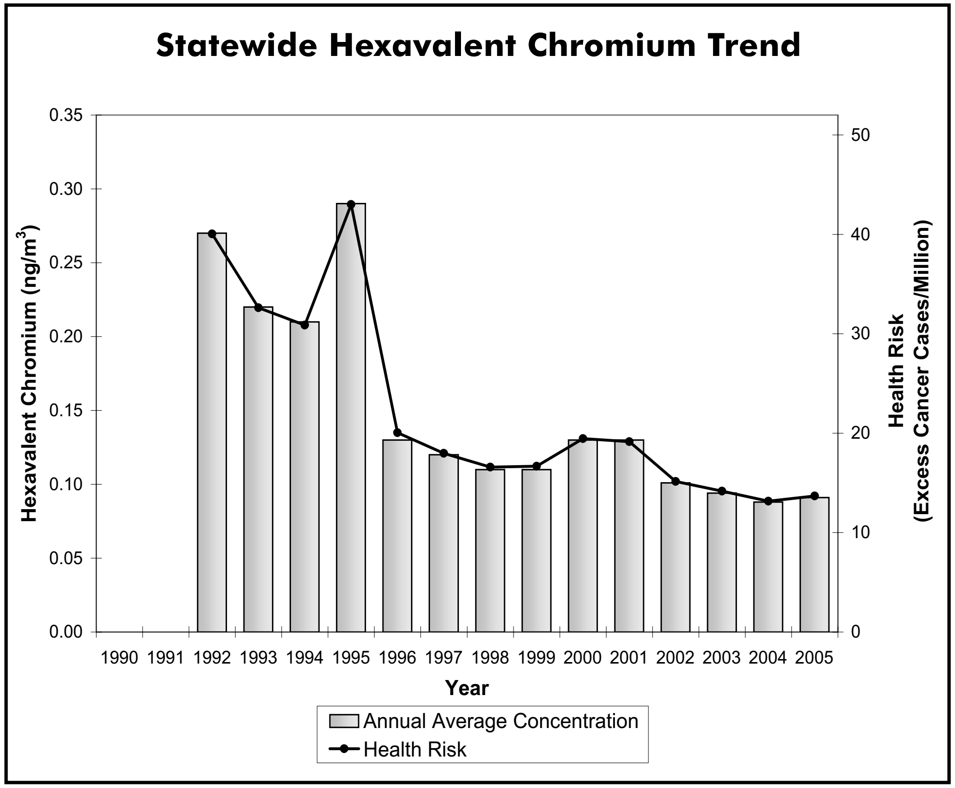

Figure 5-7

The statewide annual average concentrations and associated health risks are shown in Figure 5-7. Both show a general downward trend, with the exception of 1995. The high 1995 value is driven in part by an extremely high annual average for the Burbank site in the South Coast Air Basin. However, a number of other sites also had higher concentrations in 1995 than in other years. Between 1996 and 2005, values show significant improvement, except for slight elevated values in 2000 and 2001.

The significant reduction in hexavalent chromium coincided with the complete implementation of the chrome plating and the chromate-treated cooling tower control measures. The measures were so effective that they resulted in a very high percentage of the measured values being below the LOD. From 1998 through 2001, the lowest level that could reliably be measured was 0.2 nanograms per cubic meter (ng/m^3.). In calculating an annual average, values below 0.2 ng/m^3 are assumed equal to 0.1 ng/m^3, which is half the LOD. This approach applies to all other TACs when their measurements are below their respective LODs. Starting on January 1, 2002, hexavalent chromium is being analyzed by compositing quarterly samples by site. Although the new method decreases the number of samples, it increases the sensitivity of the instrument by lowering the lowest concentration that can be reliably measured from 0.2 ng/m^3 to 0.06 ng/m^3. Using the new method, measurements will sometimes fall below the LOD, and the half detection limit approach is applied to those measurements.

To examine the trend in hexavalent chromium while minimizing the influences of weather on the trend, the average hexavalent chromium concentration for 1992-1994 was compared to that for 2003-2005. The result is a 61 percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level. In 2005, there were an estimated 14 excess cancer cases per million people. Based on data for the ten TACs presented in this almanac, hexavalent chromium ranks sixth in terms of ambient health risk. It is important to note that since hexavalent chromium exposure and health impacts usually occur on a neighborhood scale, actual health risk can be higher in some areas than the statewide average, and lower in other areas.

para-Dichlorobenzene
2006 Statewide Emission Inventory

The ARB identified *para*-dichlorobenzene as a TAC in April 1993 under AB 2728. This bill required the ARB to identify, by regulation, all federal hazardous air pollutants as TACs. In California, *para*-dichlorobenzene has been identified as a carcinogen. In addition to the carcinogenic impact, long-term inhalation exposure may affect the liver, skin, and central nervous system in humans.

The primary area-wide sources that have reported emissions of *para*-dichlorobenzene include consumer products such as non-aerosol insect repellants and solid/gel air fresheners. These sources contribute nearly all of the statewide *para*-dichlorobenzene emissions.

para-Dichlorobenzene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	2	<1%
Area-wide Sources	1467	100%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***1469***	***100%***

Table 5-13

2006 Top Ten Counties - *para*-Dichlorobenzene

The top ten counties account for approximately 69 percent of the statewide *para*-dichlorobenzene emissions. The South Coast Air Basin has four of the top ten counties, representing 42 percent of statewide *para*-dichlorobenzene emissions. San Diego County contributes approximately eight percent. Three counties in the San Francisco Bay Area Air Basin contribute approximately 12 percent: Santa Clara County (five percent), Alameda County (four percent), and Contra Costa County (three percent). The other two counties in the top ten are: Sacramento (four percent) and Fresno (two percent).

para-Dichlorobenzene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	383	26%
San Diego	San Diego	122	8%
Orange	South Coast	121	8%
Santa Clara	San Francisco Bay Area	71	5%
Alameda	San Francisco Bay Area	61	4%
San Bernardino	South Coast	60	4%
Riverside	South Coast	59	4%
Sacramento	Sacramento Valley	55	4%
Contra Costa	San Francisco Bay Area	40	3%
Fresno	San Joaquin Valley	36	2%

Table 5-14

para-Dichlorobenzene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of *para*-dichlorobenzene in its statewide air toxics monitoring network. Statewide annual average concentrations and health risk estimates are available for 1991 through 2005, with the exception of 1998 and 1999. No summary data are available for these years because of problems with laboratory equipment and associated data reliability. The trend graph for *para*-dichlorobenzene, shown in Figure 5-8, shows values fairly constant throughout 1991 to 1997, with slightly lower values in 1994 and 1996. Following a drop in 2000, there was an upturn in 2001 through 2002, and *para*-dichlorobenzene levels have shown very little variation between 2002 and 2005.

The increase in *para*-dichlorobenzene was likely to be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations. In 2001, the lowest level of *para*-dichlorobenzene that could be reliably measured was changed from 0.2 to 0.3 parts per billion (ppb). This change resulted in a higher percentage of *para*-dichlorobenzene samples not detectable because most samples were at less than 0.3 ppb.

In calculating an annual average, values below 0.3 ppb are assumed equal to 0.15 ppb, which is one-half of the LOD. This approach applies to all other TACs when their measurements are below the LOD. It is a good estimate for some TACs, however, it is uncertain for *para*-dichlorobenzene due to the large number of samples that were lower than the LOD. However, for consistency, this approach is applied to *para*-dichlorobenzene until a better method becomes available.

To examine the trend in *para*-dichlorobenzene, the statewide average concentration for 1991-1993 was compared to that for 2003-2005. The result is a 12 percent increase in both the concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2005, there was an estimated risk of 10 excess cancer cases per million people from this compound alone. Based on this, *para*-dichlorobenzene ranks seventh out of the ten compounds presented in this almanac. However, it is important to note that annual average concentration and health risk for *para*-dichlorobenzene are heavily influenced by its LOD.

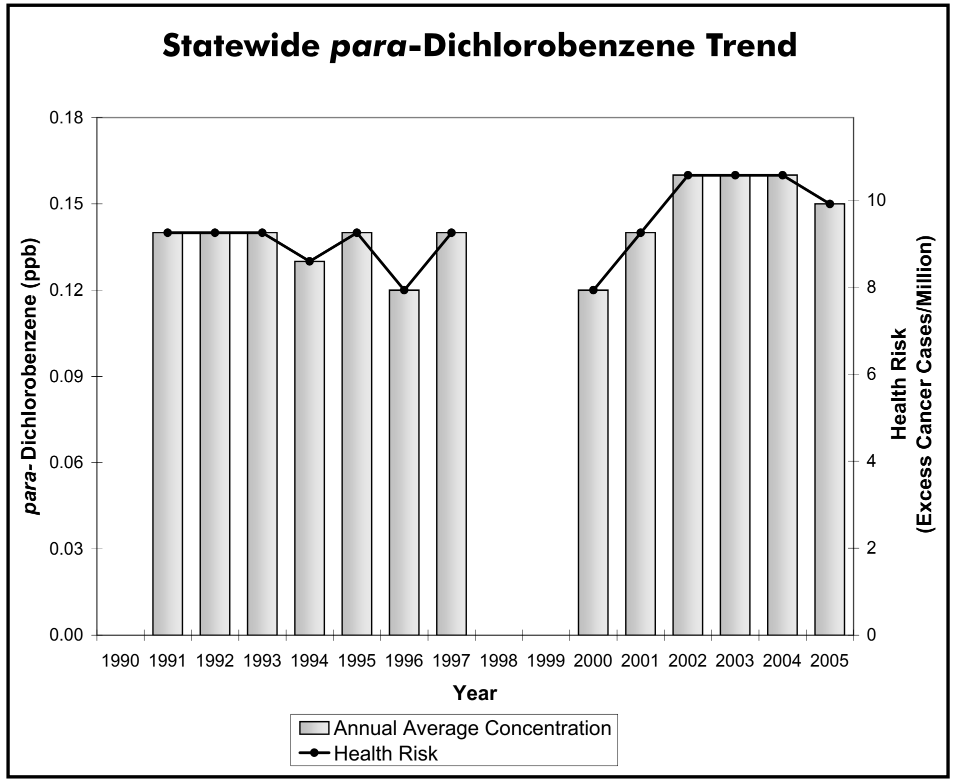

Figure 5-8

The ARB adopted an ATCM in 2004 to prohibit the use of *para*-dichlorobenzene in solid air fresheners and toilet/urinal care products. The ATCM required the phase-out of *para*-dichlorobenzene from these products by December 31, 2005, with a complete ban on the sale of the products by December 31, 2006. An emission reduction of 2.72 tons per day of *para*-dichlorobenzene was expected. Besides reducing emissions and improving air quality inside buildings and the surrounding area, the ATCM is also expected to reduce *para*-dichlorobenzene emissions from water treatment facilities processing wastewater from toilets and urinals, and therefore reduce the ambient concentration of *para*-dichlorobenzene.

Formaldehyde

2006 Statewide Emission Inventory

The ARB identified formaldehyde as a TAC in 1992 under California's TAC program (AB 1807, Tanner, 1983). In California, formaldehyde has been identified as a carcinogen. Chronic exposure is associated with respiratory symptoms and eye, nose, and throat irritation.

Formaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Photochemical oxidation is the largest source of formaldehyde concentrations in California ambient air. Directly emitted formaldehyde is a product of incomplete combustion. One of the primary sources of directly-emitted formaldehyde is vehicular exhaust. Formaldehyde is used in resins, can be found in many consumer products as an antimicrobial agent, and is also used in fumigants and soil disinfectants. About 84 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 33 percent of the total statewide formaldehyde emissions can be attributed to on-road motor vehicles, with an additional 51 percent attributed to other mobile sources such as aircraft, recreational boats, and construction and mining equipment. Area-wide sources contribute approximately nine percent and stationary sources contribute approximately eight percent of the statewide formaldehyde emissions in California. The primary area-wide sources of formaldehyde emissions include wood burning in residential fireplaces and wood stoves.

Formaldehyde		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1875	8%
Area-wide Sources	2005	9%
On-Road Mobile	7534	33%
Gasoline Vehicles	3052	13%
Diesel Vehicles	4483	19%
Other Mobile	11739	51%
Gasoline Fuel	2779	12%
Diesel Fuel	7073	31%
Other Fuel	1887	8%
Natural Sources	0	0%
Total Statewide	***23154***	***100%***

Table 5-15

2006 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 50 percent of the statewide formaldehyde emissions. The South Coast Air Basin has three of the top ten counties emitting formaldehyde, representing 24 percent of statewide formaldehyde emissions. The seven other counties in the top ten for formaldehyde emissions are: San Diego, Kern (San Joaquin Valley portion), San Bernardino (Mojave Desert portion), Alameda, Fresno, Santa Clara, and San Joaquin. These seven counties account for approximately 29 percent of statewide formaldehyde emissions.

Formaldehyde			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	3350	14%
San Diego	San Diego	1426	6%
Kern	San Joaquin Valley	1392	6%
Orange	South Coast	1064	5%
San Bernardino	Mojave Desert	915	4%
Alameda	San Francisco Bay Area	816	4%
Fresno	San Joaquin Valley	746	3%
Santa Clara	San Francisco Bay Area	682	3%
San Bernardino	South Coast	669	3%
San Joaquin	San Joaquin Valley	617	3%

Table 5-16

Formaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of formaldehyde in its statewide air toxics monitoring network. Its statewide annual average concentrations and associated health risk are available for 1990 through 2005. However, values prior to 1996 are uncertain because the data were based on a method that underestimated the actual concentrations. A method change in 1996 corrected this problem, but a correction factor could not be developed for the earlier data. While the data prior to the method change are included here for completeness, they are not directly comparable to data collected during the later years. The trend graph for formaldehyde, shown in Figure 5-9, shows a great deal of variability with a general upward trend.

To examine the trend in formaldehyde using available data while minimizing the influences of weather on the trend, the statewide average concentration for 1996-1998 was compared to that for 2003-2005 (since formaldehyde data prior to 1996 are not reliable). There is a two percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2005, there was an estimated risk of 21 excess cancer cases per million people from formaldehyde alone. Based on data for all ten TACs presented in this almanac, formaldehyde ranks fifth in terms of health risk. As with other TACs, the health risk is not spread evenly throughout the State, so in some areas the health risk is higher than the statewide average while in other areas, the health risk is lower.

Although formaldehyde is emitted by both stationary and mobile sources, mobile sources are, by far, the largest contributors. The ARB adopted the Low Emissions/Clean Fuels Regulations in 1990, and these regulations are expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. Formaldehyde, similar to acetaldehyde, can also be formed in the environment due to reactions of pollutants in the air. This secondary contribution is hard to quantify and can also contribute to fluctuations observed in the ambient levels of formaldehyde.

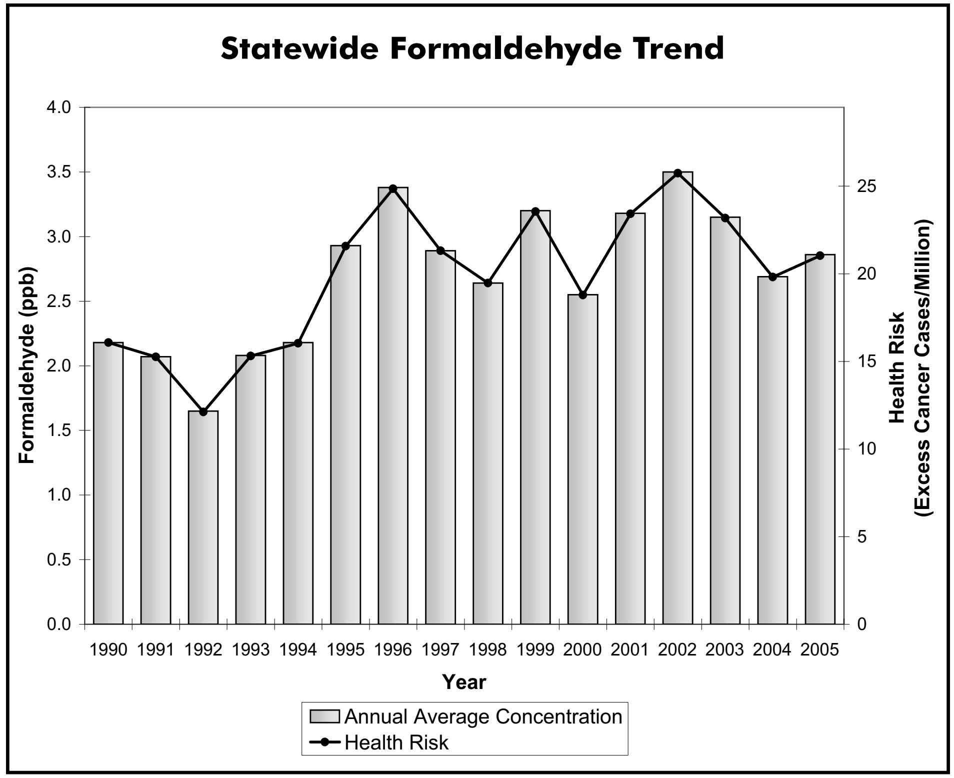

Figure 5-9

Formaldehyde also poses a problem for indoor air quality, and its concentrations indoors are generally higher. This is because many building materials, consumer products, and fabrics emit formaldehyde. As a result, indoor formaldehyde levels are expected to remain higher than outdoor levels because of new materials brought into homes, as a consequence of remodeling or purchasing new furnishings. Other indoor combustion sources such as wood and gas stoves, kerosene heaters, and cigarettes also contribute to indoor formaldehyde levels, although intermittently.

On April 26, 2007, the ARB adopted an ATCM to reduce formaldehyde emissions from three composite wood products: hardwood plywood, particleboard, and medium density fiberboard. Composite wood is a general term for wood-based panels made from wood pieces, particles or fibers bonded together with a resin. Based on the average emissions of existing composite wood products, the adopted ATCM would reduce emissions of formaldehyde by about 20 percent in Phase 1 (2009) or about 180 tons per year. In Phase 2 (2011-2012), a 57 percent reduction in formaldehyde emissions or 500 tons per year would be achieved. Because the ATCM would reduce indoor formaldehyde exposures, substantial benefits would be realized by buyers of new homes as well as those with existing homes due to reduced emissions from remodeling projects and new furniture. The Phase 1 standards would reduce the number of formaldehyde-related childhood exposure cancer cases by 3 to 9, and the lifetime exposure cancer cases by 12 to 35 per million. In Phase 2, childhood exposure cancer cases would be reduced by 9 to 26, and lifetime exposure cancer cases by 35 to 97 per million.

Methylene Chloride

2006 Statewide Emission Inventory

The ARB identified methylene chloride as a TAC in 1987 under California's TAC program. In California, methylene chloride has been identified as a carcinogen. In addition, chronic exposure can lead to bone marrow, hepatic, and renal toxicity.

Methylene chloride is used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic fabrication, and as a solvent in paint stripping operations. Paint removers account for the largest use of methylene chloride in California, where methylene chloride is the main ingredient in many paint stripping formulations. Plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers are stationary sources reporting emissions of methylene chloride. These sources contribute approximately 45 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 55 percent.

Methylene Chloride		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	2927	45%
Area-wide Sources	3599	55%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***6527***	***100%***

Table 5-17

2006 Top Ten Counties - Methylene Chloride

The top ten counties account for approximately 74 percent of the statewide methylene chloride emissions. The South Coast Air Basin has four of the top ten counties emitting methylene chloride, representing 54 percent of statewide methylene chloride emissions. Three counties in the San Francisco Bay Area Air Basin contribute approximately nine percent: Santa Clara County (four percent), Alameda County (three percent) and Contra Costa (two percent). The three other counties in the top ten for methylene chloride emissions are: San Diego, Sacramento, and Ventura. Together, these three counties account for approximately 11 percent of statewide methylene chloride emissions.

Methylene Chloride			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2078	32%
Orange	South Coast	938	14%
San Diego	San Diego	367	6%
San Bernardino	South Coast	271	4%
Santa Clara	San Francisco Bay Area	265	4%
Riverside	South Coast	226	3%
Alameda	San Francisco Bay Area	216	3%
Sacramento	Sacramento Valley	182	3%
Ventura	South Central Coast	161	2%
Contra Costa	San Francisco Bay Area	123	2%

Table 5-18

Methylene Chloride

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of methylene chloride in its statewide air toxics monitoring network. The trend graph in Figure 5-10 shows an overall downward trend with some variability, particularly during the early years. The drop in 2001 was substantial, and a slight downward trend has continued between 2002 and 2005. To examine the trend in methylene chloride while minimizing the influences of weather on the trend, the statewide average methylene chloride concentration for 1990-1992 was compared to that for 2003-2005. The result is a 75 percent decrease in both concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2005, there was an estimated risk from methylene chloride of less than one excess cancer case per million people. Of the ten compounds presented in this almanac, methylene chloride presents the lowest health risk, on a statewide basis. However, any level of risk is a concern from a public health standpoint.

In California, paint removers account for the largest use of methylene chloride, which is the primary ingredient in paint stripping formulations used for industrial, commercial, military, and domestic applications. The use of methylene chloride in consumer and automotive products has been significantly reduced through aggressive regulations adopted by the ARB. These regulations have reduced ambient concentrations and health risks.

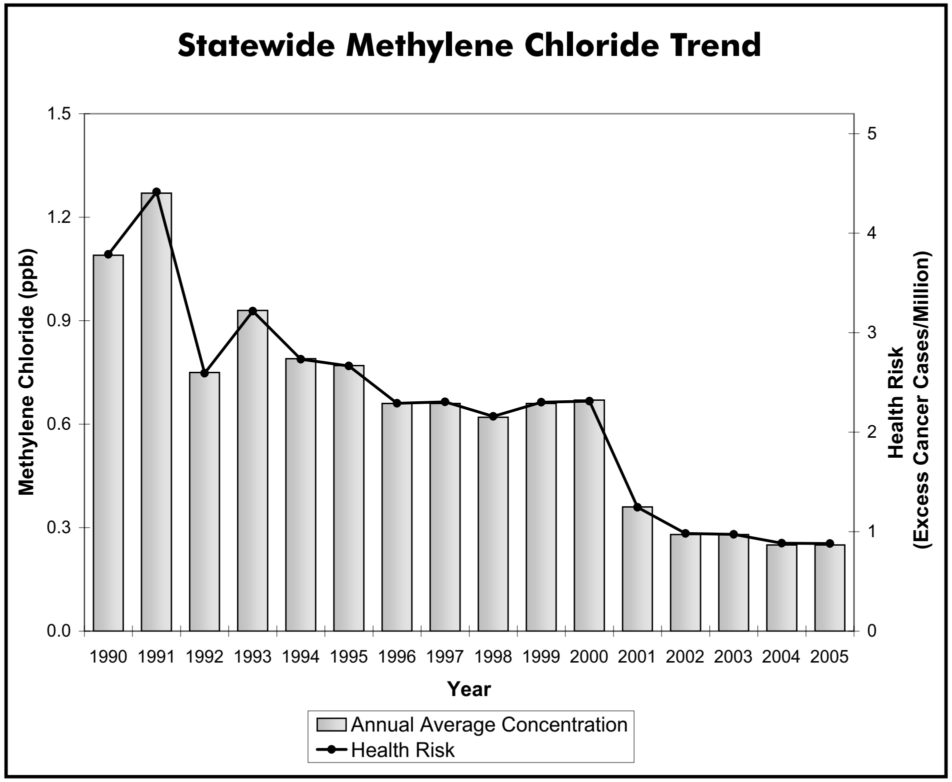

Figure 5-10

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Perchloroethylene

2006 Statewide Emission Inventory

The ARB identified perchloroethylene as a TAC in 1991 under California's TAC program (AB 1807, Tanner, 1983). In California, perchloroethylene has been identified as a carcinogen. Perchloroethylene vapors are irritating to the eyes and respiratory tract. Following chronic exposure, workers have shown signs of liver toxicity, as well as kidney dysfunction and neurological effects.

Perchloroethylene is used as a solvent, primarily in dry cleaning operations. Perchloroethylene is also used in degreasing operations, paints and coatings, adhesives, aerosols, specialty chemical production, printing inks, silicones, rug shampoos, and laboratory solvents. In California, the stationary sources that have reported emissions of perchloroethylene are dry cleaning plants, aircraft part and equipment manufacturers, and fabricated metal product manufacturers. These stationary sources account for 56 percent of the statewide emissions of perchloroethylene. Area-wide sources contribute approximately 44 percent. The primary area-wide sources include consumer products such as automotive brake cleaners and tire sealants and inflators.

Perchloroethylene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	2742	56%
Area-wide Sources	2123	44%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***4865***	***100%***

Table 5-19

2006 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 69 percent of the statewide perchloroethylene emissions. The South Coast Air Basin has four of the top ten counties emitting perchloroethylene, representing 43 percent of statewide perchloroethylene emissions. San Diego County contributes approximately nine percent. The five other counties in the top ten for perchloroethylene emissions are: Sacramento, Santa Clara, Alameda, Fresno, and San Joaquin. These five counties account for approximately 18 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	1263	26%
San Diego	San Diego	422	9%
Orange	South Coast	419	9%
Sacramento	Sacramento Valley	251	5%
San Bernardino	South Coast	212	4%
Riverside	South Coast	199	4%
Santa Clara	San Francisco Bay Area	172	4%
Alameda	San Francisco Bay Area	169	3%
Fresno	San Joaquin Valley	159	3%
San Joaquin	San Joaquin Valley	111	2%

Table 5-20

Perchloroethylene

Statewide Air Quality and Health Risk

The ARB routinely monitors outdoor levels of perchloroethylene in its statewide air toxics monitoring network. Although the trend graph for perchloroethylene in Figure 5-11 shows some variability during the early 1990s, there is an overall downward trend. To examine the trend in perchloroethylene over the monitoring period of record and to minimize the influences of weather on the trend, the statewide perchloroethylene concentration for 1990-1992 was compared to that for 2003-2005. The result is an 80 percent decrease in both concentration and health risk. For 1999, complete and representative data are not available.

In Figure 5-11, health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level. During 2005, there was an estimated risk of two excess cancer cases per million people. Based on this, perchloroethylene ranks ninth out of the ten compounds presented in this almanac.

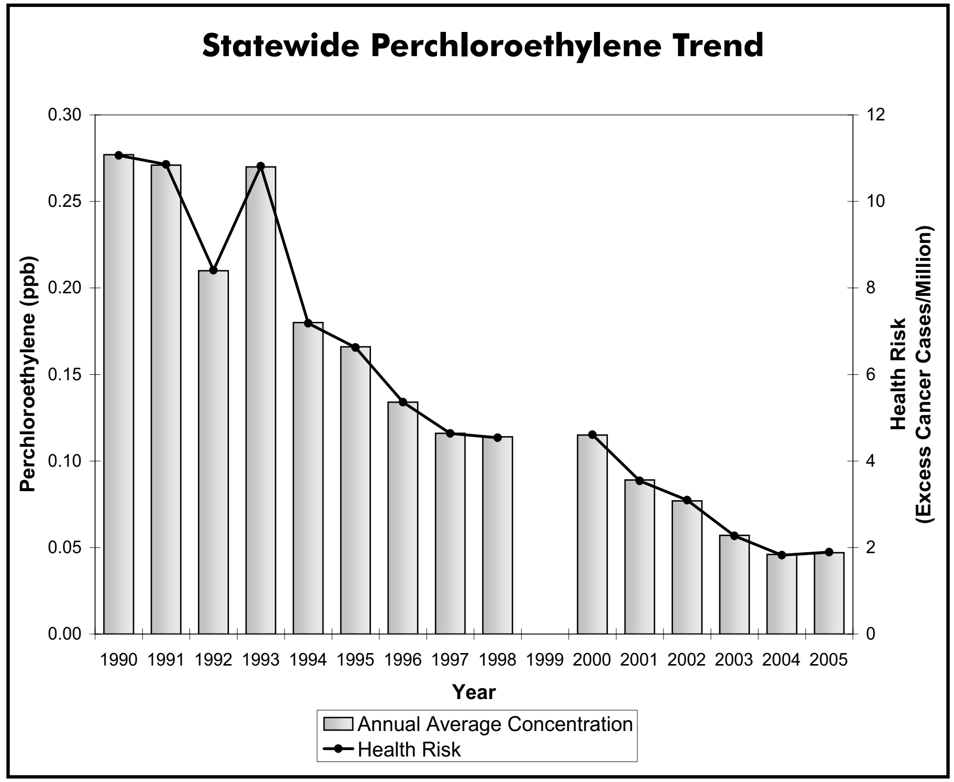

Figure 5-11

When the ARB identified perchloroethylene as a TAC in October 1991, it was estimated that 60 percent of perchloroethylene came from dry cleaning operations. Examination of industry practices suggested the potential for significant reductions of emissions. The ARB focused control efforts on that industry and adopted a control measure governing the use of perchloroethylene in dry cleaning operations in 1993. In 2007, the ARB approved amendments to the Dry Cleaning ATCM which will virtually eliminate the potential health risk due to perchloroethylene emissions from dry cleaning machines. The approved amendments prohibit any new installation of perchloroethylene dry cleaning machines beginning on January 1, 2008 and begin a phase-out of existing machines. The complete phase out of perchloroethylene machines in dry cleaning operations will occur by January 1, 2023. Additionally, while perchloroethylene dry cleaning machines remain in use, the ARB will continue to provide training for dry cleaners on improved practices and methods for reducing emissions.

In addition, the ARB has developed control measures that prohibit the use of perchloroethylene in automotive and many consumer products, including aerosol coatings and adhesives.

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Diesel Particulate Matter

2006 Statewide Emission Inventory

The ARB identified the PM emissions from diesel-fueled engines as a TAC in August 1998 under California's TAC program. In California, diesel engine exhaust has been identified as a carcinogen. Most researchers believe that diesel exhaust particles contribute the majority of the risk.

Diesel PM is emitted from both mobile and stationary sources. In California, on-road diesel-fueled vehicles contribute approximately 40 percent of the statewide total, with an additional 57 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources, contributing about three percent of emissions, include shipyards, warehouses, heavy equipment repair yards, and oil and gas production operations. Emissions from these sources are from diesel-fueled internal combustion engines. Stationary sources that report diesel PM emissions also include heavy construction (except highway), manufacturers of asphalt paving materials and blocks, and electrical generation.

Readers may note that the stationary source diesel PM emission estimates differ from those presented in previous editions of the almanac and in the ARB's October 2000 report entitled: "*Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*" (Diesel Risk Reduction Plan or Plan). This is because they incorporate more recent data and have been calculated with updated methodologies developed for new regulations. These regulations are those that were recommended in the Diesel Risk Reduction Plan. The on-road mobile source emissions cited in the Diesel Risk Reduction Plan are based on an earlier version of EMFAC2001 (EMFAC1.99(f) 6/26/00), whereas the current estimates are based on EMFAC2007. The other mobile inventory includes revised estimates for ship diesel PM emissions. In 2005, ARB staff improved the methodology for estimating ship emissions by developing a consistent statewide methodology that incorporates more recent data on ship activities and emission factors. This has resulted in an increase of approximately 119 percent increase in the estimates for ship emissions as compared to estimates developed with previous methodologies.

Diesel PM		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1227	3%
Area-wide Sources	0	0%
On-Road Mobile	16936	40%
Gasoline Vehicles	0	0%
Diesel Vehicles	16936	40%
Other Mobile	24163	57%
Gasoline Fuel	0	0%
Diesel Fuel	24163	57%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***42326***	***100%***

Table 5-21

2006 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 51 percent of the statewide diesel PM emissions. The South Coast Air Basin has four of the top ten counties emitting diesel particulate matter which represents 24 percent of statewide diesel PM emissions. Alameda contributes four percent, and San Diego contributes five percent. Three counties in the San Joaquin Air Basin contribute 11 percent: Kern (five percent), Fresno (four percent), and San Joaquin (three percent). The Mojave Desert portion of San Bernardino contributes approximately four percent.

Diesel PM			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	6525	15%
Kern	San Joaquin Valley	2099	5%
San Diego	San Diego	2083	5%
San Bernardino	Mojave Desert	1759	4%
Orange	South Coast	1587	4%
Alameda	San Francisco Bay Area	1584	4%
Fresno	San Joaquin Valley	1519	4%
San Joaquin	San Joaquin Valley	1213	3%
San Bernardino	South Coast	1075	3%
Riverside	South Coast	1058	2%

Table 5-22

Diesel Particulate Matter

Statewide Air Quality and Health Risk

The exhaust from diesel-fueled engines is a complex mixture of gases, vapors, and particles, many of which are known human carcinogens. More than 40 diesel exhaust components are listed by the State and federal governments as TACs or hazardous air pollutants. Most researchers believe that diesel PM contributes to the majority of the risk from exposure to diesel exhaust because the particles carry many of the harmful organics and metals present in the exhaust.

Unlike the other TACs presented in this almanac, the ARB does not monitor outdoor diesel PM because there is no routine method for monitoring ambient concentrations. However, the ARB made a preliminary estimation of diesel PM concentrations for the State's 15 air basins and for the State as a whole using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies with chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate statewide outdoor concentrations of diesel PM. The ARB subsequently updated the original statewide estimates based on the ratio between the previous estimate for 1990 and the most recent diesel PM emission inventory for the year 1990. The details of the methodology are described in Appendix VI to the ARB Diesel Risk Reduction Plan.

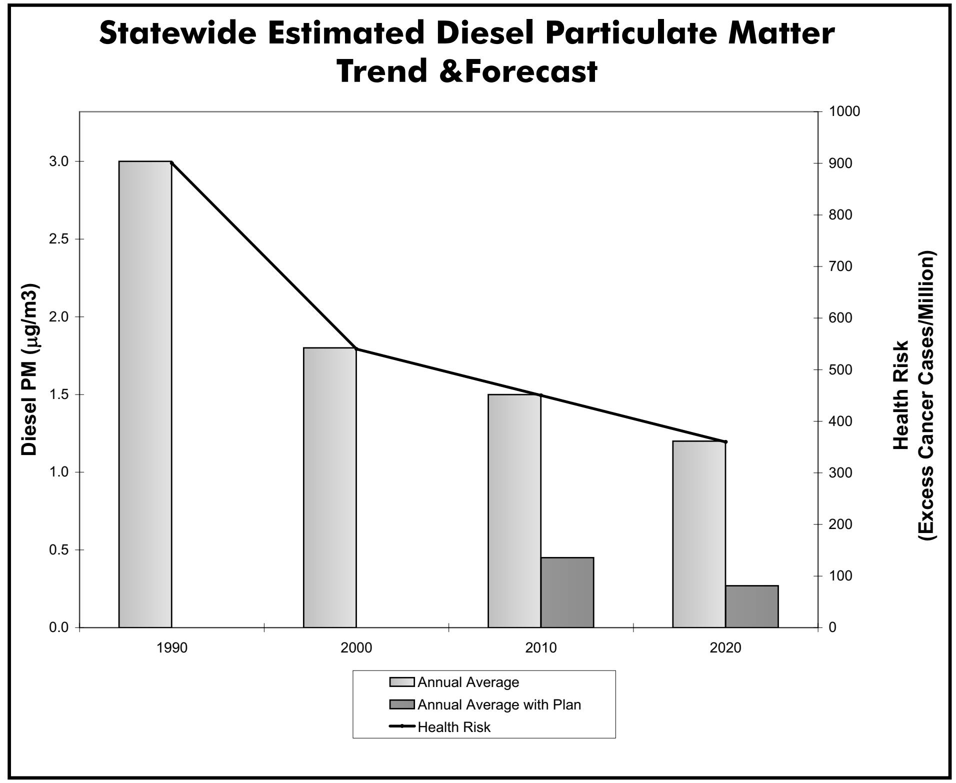


Figure 5-12

The updated statewide population-weighted average diesel PM concentrations and health risk for various years are shown in Figure 5-12. The average statewide concentration for 1990 was estimated at 3.0 micrograms per cubic meter ($\mu g/m^3$). This is associated with a health risk of 900 excess cancer cases per million people exposed over a 70-year lifetime. The estimates for 2000 show a 40 percent drop from 1990, with a concentration of 1.8 $\mu g/m^3$ and an associated health risk of 540 excess cancer cases per million people. In addition, the ARB estimated population-weighted concentrations for 2010 and 2020. Two estimates are given for each of these years: one reflecting the estimated ambient concentrations without implementing the Diesel Risk Reduction Plan and one reflecting the estimated ambient concentrations with implementation of control measures in the Diesel Risk Reduction Plan. These future year estimates are based on linear extrapolations from the 1990 emissions inventory and linear rollback techniques. It is important to note that the estimated risk from diesel PM is higher than the risk from all other TACs combined, and this TAC poses the most significant risk to California's citizens. In fact, the ARB estimates that 77 percent of the known statewide cancer risk from the top 10 outdoor air toxics is attributable to diesel PM.

The Diesel Risk Reduction Plan provides a mechanism for combating the diesel PM problem. Without implementing the Plan, concentrations in 2010 and 2020 are estimated to drop by only about 17 percent and 33 percent, respectively, from the estimated year 2000 level. However, the goal of the Plan is to reduce concentrations by 75 percent by 2010 and 85 percent by 2020. The key elements of the Plan are to clean up existing engines through engine retrofit emission control devices, to adopt stringent standards for new diesel engines, and to lower the sulfur content of diesel fuel to protect new, and very effective, advanced technology emission control devices on diesel engines. When fully implemented, the Diesel Risk Reduction Plan will significantly reduce emissions from both old and new diesel-fueled motor vehicles and from stationary sources that burn diesel fuel. In addition to these strategies, the ARB continues to promote the use of alternative fuels and electrification. As a result of these actions, diesel PM concentrations and associated health risks should continue to decline.

South Coast Air Basin
2006 Emission Inventory by Compound

Acetaldehyde

Approximately 95 percent of the emissions of acetaldehyde are from mobile sources.

Benzene

The primary sources of benzene emissions in the South Coast Air Basin are mobile sources (approximately 95 percent).

South Coast - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	17	1%	<1%
Area-wide Sources	90	4%	1%
On-Road Mobile	869	38%	9%
Gasoline Vehicles	327	14%	3%
Diesel Vehicles	543	24%	5%
Other Mobile	1325	58%	13%
Gasoline Fuel	265	11%	3%
Diesel Fuel	1049	46%	10%
Other Fuel	11	<1%	<1%
Natural Sources	0	0%	0%
Total	2302	100%	23%
Total Statewide	**10023**		

Table 5-23

South Coast - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	142	4%	1%
Area-wide Sources	45	1%	0%
On-Road Mobile	2109	59%	17%
Gasoline Vehicles	1962	55%	16%
Diesel Vehicles	148	4%	1%
Other Mobile	1282	36%	11%
Gasoline Fuel	987	28%	8%
Diesel Fuel	286	8%	2%
Other Fuel	10	0%	0%
Natural Sources	0	0%	0%
Total	3578	100%	30%
Total Statewide	**12060**		

Table 5-24

1,3-Butadiene

Approximately 89 percent of the emissions of 1,3-butadiene are from mobile sources.

Carbon Tetrachloride

Stationary sources, such as chemical manufacturers and petroleum refineries, account for all of the emissions of carbon tetrachloride.

South Coast - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	5	1%	0%
Area-wide Sources	20	3%	1%
On-Road Mobile	428	56%	12%
Gasoline Vehicles	414	54%	12%
Diesel Vehicles	14	2%	0%
Other Mobile	251	33%	7%
Gasoline Fuel	224	29%	6%
Diesel Fuel	27	4%	1%
Other Fuel	< 1	0%	0%
Natural Sources	62	8%	2%
Total	766	100%	21%
Total Statewide	**3589**		

Table 5-25

South Coast - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.75	100%	39%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.75	100%	39%
Total Statewide	**1.96**		

Table 5-26

Chromium, Hexavalent

On-road mobile sources account for 66 percent of the hexavalent chromium emissions. Approximately 33 percent of the hexavalent chromium emissions are from stationary sources such as chrome platers, aircraft and parts manufacturing, and fabricated metal product manufacturing.

South Coast - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.03	33%	3%
Area-wide Sources	< .01	1%	0%
On-Road Mobile	0.07	66%	6%
Gasoline Vehicles	0.06	64%	5%
Diesel Vehicles	< .01	2%	0%
Other Mobile	< .01	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	< .01	0%	0%
Other Fuel	< .01	0%	0%
Natural Sources	0	0%	0%
Total	0.10	100%	9%
Total Statewide	**1.17**		

Table 5-27

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

South Coast - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	623	100%	42%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	623	100%	42%
Total Statewide	**1469**		

Table 5-28

Formaldehyde

Approximately 90 percent of the formaldehyde emissions are from mobile sources.

South Coast - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	357	6%	2%
Area-wide Sources	186	3%	1%
On-Road Mobile	2183	39%	9%
Gasoline Vehicles	1097	19%	5%
Diesel Vehicles	1087	19%	5%
Other Mobile	2942	52%	13%
Gasoline Fuel	810	14%	3%
Diesel Fuel	2100	37%	9%
Other Fuel	32	1%	0%
Natural Sources	0	0%	0%
Total	5668	100%	24%
Total Statewide	**23154**		

Table 5-29

Methylene Chloride

Approximately 57 percent of the emissions of methylene chloride are from stationary sources such as plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers.

South Coast - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	2004	57%	31%
Area-wide Sources	1509	43%	23%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	3514	100%	54%
Total Statewide	**6527**		

Table 5-30

Perchloroethylene

Approximately 57 percent of the emissions of perchloroethylene are from dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

South Coast - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1195	57%	25%
Area-wide Sources	898	43%	18%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2093	100%	43%
Total Statewide	**4865**		

Table 5-31

Diesel Particulate Matter

Approximately 98 percent of the emissions of diesel PM are from mobile sources.

South Coast - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	199	2%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	4249	41%	10%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	4249	41%	10%
Other Mobile	5797	57%	14%
Gasoline Fuel	0	0%	0%
Diesel Fuel	5797	57%	14%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	10245	100%	24%
Total Statewide	**42326**		

Table 5-32

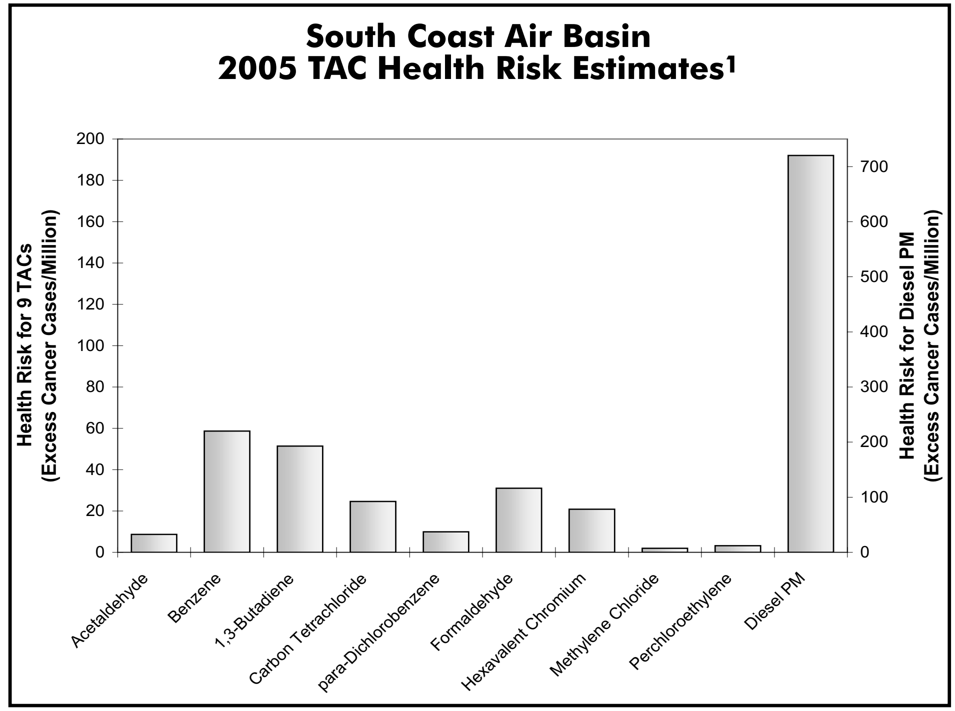
South Coast Air Basin

Air Quality and Health Risk

From 1990 through 2005, the ARB monitored outdoor concentrations for various TACs at seven sites in the South Coast Air Basin. Data are available for most of the years at sites located in Burbank, Los Angeles, North Long Beach, and Riverside. Measurements for 1990 through 1997 are also available from a site at Upland. In addition, there are data for 1998 at a site in Fontana. During December 1999, monitoring activities for most of the TACs at Fontana were relocated to Azusa. Annual average concentration and associated health risk are not available for the year during which the site was moved because neither site had a full year of data. This almanac focuses on the top ten TACs based on available data. It is important to note that there are other compounds which pose a significant risk, but have insufficient data or are not monitored, so they are not included in the almanac.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the South Coast Air Basin, are provided in Table 5-33. Data for individual sites are provided in Appendix C. Figure 5-13 shows individual health risk from the ten TACs for the South Coast Air Basin. As indicated on the graph, the health risk data reflect the year of 2005 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.



[1] *Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2005.*

Figure 5-13

Diesel PM poses the greatest health risk among the ten TACs. In the South Coast Air Basin, the estimated health risk from diesel PM was 720 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 33 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2003-2005. The health risks of 1,3-butadiene and benzene have been reduced by 71 percent and 78 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 59 percent and 83 percent, respectively.

Carbon tetrachloride data show a 33 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2005 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2003-2005. Acetaldehyde and formaldehyde show a 12 percent and 11 percent reduction, respectively.

Para-dichlorobenzene data show a nine percent decrease comparing periods between 1991-1993 and 2003-2005. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The ARB is exploring options to better assess the *para*-dichlorobenzene concentrations that are below its LOD.

Hexavalent chromium data show a 56 percent decrease comparing periods between 1992-1994 and 2003-2005. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. To better assess the hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

Overall, in the South Coast Air Basin, all TACs have shown improvement since 1990, but their health risks are still higher than the statewide levels. It is important to note that there may be other compounds that pose a significant health risk but are not monitored. Reductions in ambient TAC concentrations and health risks should continue, as new rules and regulations are implemented to control TACs.

In addition to the routine monitoring, a special study was conducted at two sites located in the Boyle Heights and Wilmington areas of Los Angeles between February 2001 and May 2002 (Boyle Heights) and between May 2001 and July 2002 (Wilmington). Monitoring included both TACs and criteria air pollutants. Limited monitoring of a few pollutants was conducted at two satellite sites in Boyle Heights from March 2001 through October 2001, and at one satellite site in Wilmington from November 2001 through May 2002. The Boyle Heights and Wilmington communities are both located near major freeways. The Wilmington community is also located near oil refineries and port facilities. Although not included in this almanac, data from Boyle Heights, Wilmington, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

South Coast Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																	
TAC	**Conc.[1]/Risk[2]**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Acetaldehyde	Annual Avg	2.46	3	2.46	2.67	2.3	0.97	2.08	1.77	1.54	1.63	1.26	1.47	1.41	1.47	1.46	1.79
	Health Risk	12	15	12	13	11	5	10	9	7	8	6	7	7	7	7	9
Benzene	Annual Avg	3.42	2.91	2.61	2.17	2.4	1.89	1.45	1.34	1.25	1.2	0.97	0.86	0.769	0.745	0.589	0.634
	Health Risk	317	269	242	201	222	175	134	124	116	111	90	80	71	69	55	59
1,3-Butadiene	Annual Avg	0.532	0.452	0.498	0.565	0.497	0.459	0.39	0.378	0.354	0.328	0.251	0.251	0.211	0.147	0.143	0.137
	Health Risk	200	170	187	212	187	173	146	142	133	123	94	94	79	55	54	51
Carbon Tetrachloride	Annual Avg	0.136	0.134		0.105		0.102	0.079		0.114		0.096	0.086	0.092	0.093		
	Health Risk	36	35		28		27	21		30		25	23	24	25		
Chromium, Hexavalent	Annual Avg			0.39	0.29	0.29	0.46	0.18	0.17	0.15	0.14	0.18		0.179	0.158	0.126	0.139
	Health Risk			59	43	43	69	27	25	22	22	27		27	24	19	21
para-Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13			0.13	0.15	0.16	0.17	0.16	0.15
	Health Risk		11	13	11	8	11	7	9			9	10	11	11	11	10
Formaldehyde	Annual Avg	2.92	3.08	2.22	3.22	3.14	3.57	5.06	4.47	3.79	4.06	3.13	4.13	4.16	3.83	3.76	4.21
	Health Risk	22	23	16	24	23	26	37	33	28	30	23	30	31	28	28	31
Methylene Chloride	Annual Avg	1.86	1.51	0.9	1.23	1.1	1.28	0.95	1.14	0.85	0.92	0.83	0.63	0.57	0.59	0.57	0.57
	Health Risk	6	5	3	4	4	4	3	4	3	3	3	2	2	2	2	2
Perchloroethylene	Annual Avg	0.576	0.547	0.412	0.448	0.393	0.364	0.32	0.274	0.259		0.207	0.176	0.146	0.105	0.082	0.08
	Health Risk	23	22	16	18	16	15	13	11	10		8	7	6	4	3	3
Diesel PM[3]	*Annual Avg*	*(3.6)*					*(2.7)*					*(2.4)*					
	Health Risk	*(1080)*					*(810)*					*(720)*					
Average Basin Risk	w/o Diesel PM	*616*	550	548	554	514	*505*	398	357	349	297	*285*	253	258	225	179	186
	w/ Diesel PM	***(1696)***					***(1315)***					***(1005)***					

1 Concentrations for Hexavalent Chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.
2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*
3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-33

San Francisco Bay Area Air Basin
2006 Emission Inventory by Compound

Acetaldehyde

Approximately 80 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion and agricultural burning contribute approximately 19 percent.

San Francisco Bay Area - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	7	0%	0%
Area-wide Sources	294	19%	3%
On-Road Mobile	350	23%	3%
Gasoline Vehicles	166	11%	2%
Diesel Vehicles	185	12%	2%
Other Mobile	869	57%	9%
Gasoline Fuel	113	7%	1%
Diesel Fuel	609	40%	6%
Other Fuel	147	10%	1%
Natural Sources	0	0%	0%
Total	1521	100%	15%
Total Statewide	10023		

Table 5-34

Benzene

Mobile sources are the primary sources of benzene emissions in the San Francisco Bay Area Air Basin (approximately 92 percent).

San Francisco Bay Area - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	114	6%	1%
Area-wide Sources	38	2%	0%
On-Road Mobile	1031	56%	9%
Gasoline Vehicles	981	53%	8%
Diesel Vehicles	50	3%	0%
Other Mobile	653	36%	5%
Gasoline Fuel	427	23%	4%
Diesel Fuel	166	9%	1%
Other Fuel	60	3%	0%
Natural Sources	0	0%	0%
Total	1836	100%	15%
Total Statewide	12060		

Table 5-35

1,3-Butadiene

Most of the emissions of 1,3-butadiene are from mobile sources.

San Francisco Bay Area - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	2	0%	0%
Area-wide Sources	2	1%	0%
On-Road Mobile	211	53%	6%
Gasoline Vehicles	206	52%	6%
Diesel Vehicles	5	1%	0%
Other Mobile	161	41%	4%
Gasoline Fuel	96	24%	3%
Diesel Fuel	16	4%	0%
Other Fuel	49	12%	1%
Natural Sources	19	5%	1%
Total	394	100%	11%
Total Statewide	**3589**		

Table 5-36

Carbon Tetrachloride

Stationary sources, such as chemical and petroleum refineries, account for all of the emissions of carbon tetrachloride.

San Francisco Bay Area - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.94	100%	48%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.94	100%	48%
Total Statewide	**1.96**		

Table 5-37

Chromium, Hexavalent

Approximately 62 percent of the hexavalent chromium emissions are from other mobile sources. On-road mobile sources account for approximately 32 percent of hexavalent chromium emissions. Stationary sources such as electrical generation and fabricated metal product manufacturing contribute approximately four percent.

San Francisco Bay Area - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< .01	6%	0%
Area-wide Sources	< .01	1%	0%
On-Road Mobile	0.03	32%	2%
Gasoline Vehicles	0.02	31%	2%
Diesel Vehicles	< .01	1%	0%
Other Mobile	0.05	62%	4%
Gasoline Fuel	< .01	0%	0%
Diesel Fuel	< .01	0%	0%
Other Fuel	0.05	61%	4%
Natural Sources	0	0%	0%
Total	0.08	100%	7%
Total Statewide	**1.17**		

Table 5-38

para-Dichlorobenzene

Emissions of *para*-dichlorobenzene are essentially all from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Francisco Bay Area - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	278	100%	19%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	279	100%	19%
Total Statewide	**1469**		

Table 5-39

Formaldehyde

Approximately 84 percent of the formaldehyde emissions are from mobile sources.

Methylene Chloride

Approximately 72 percent of the emissions of methylene chloride are from area-wide sources.

San Francisco Bay Area - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	175	5%	1%
Area-wide Sources	384	11%	2%
On-Road Mobile	913	26%	4%
Gasoline Vehicles	543	16%	2%
Diesel Vehicles	369	11%	2%
Other Mobile	2016	58%	9%
Gasoline Fuel	344	10%	1%
Diesel Fuel	1219	35%	5%
Other Fuel	453	13%	2%
Natural Sources	0	0%	0%
Total	3488	100%	15%
Total Statewide	23154		

Table 5-40

San Francisco Bay Area - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	271	28%	4%
Area-wide Sources	692	72%	11%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	963	100%	15%
Total Statewide	6527		

Table 5-41

Perchloroethylene

Approximately 57 percent of the emissions of perchloroethylene are from such area-wide sources as automotive brake cleaners and other consumer products.

San Francisco Bay Area - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	306	43%	6%
Area-wide Sources	402	57%	8%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	709	100%	15%
Total Statewide	4865		

Table 5-42

Diesel Particulate Matter

Emissions of diesel PM are primarily from mobile sources.

San Francisco Bay Area - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	82	2%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	1424	30%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1424	30%	3%
Other Mobile	3191	68%	8%
Gasoline Fuel	0	0%	0%
Diesel Fuel	3191	68%	8%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	4697	100%	11%
Total Statewide	42326		

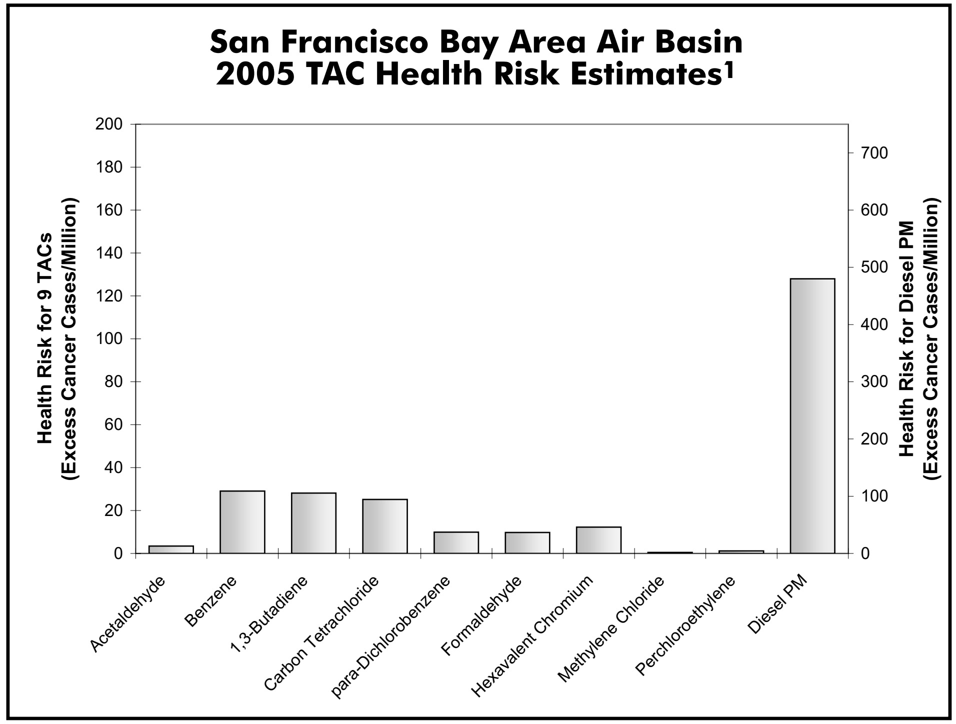
Table 5-43

San Francisco Bay Area Air Basin

Air Quality and Health Risk

From 1990 through 2005, the ARB monitored outdoor concentration for various TACs at six sites in the San Francisco Bay Area Air Basin. Data for the entire time period are available from sites located in Fremont and San Francisco. The San Jose-Fourth Street site has measurements from 1990 through 2001; this site was relocated to San Jose-Jackson Street in mid-2002. Data are also available from a site at Concord from 1990 through 1999. In addition, there was a monitor at Richmond from 1990 through April 1997. This site was relocated to San Pablo and began sampling there in May 1997. At the end of February 2000, TAC monitoring was discontinued at the Concord and San Pablo sites, and additional data from these sites will not be available. Annual average concentration and associated health risk are unavailable for the year during a site move because neither site has a full year of data. This almanac focuses on the top ten TACs based on available data. It is important to note that there are other compounds which pose a significant risk, but have insufficient data or are not monitored, so they are not included in the almanac.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Francisco Bay Area Air Basin, are provided in Table 5-44. Data for individual sites are provided in Appendix C. Figure 5-14 shows individual health risk from the ten TACs for the San Francisco Bay Area Air Basin. As indicated on the graph, the health risk data reflect the year of 2005 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.



[1] Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2005.

Figure 5-14

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the San Francisco Bay Area Air Basin, the estimated health risk from diesel PM was 480 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 36 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2003-2005. The health risks of 1,3-butadiene and benzene have been reduced by 71 percent and 80 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 88 percent and 83 percent, respectively.

Carbon tetrachloride data show a 29 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2005 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2003-2005. Acetaldehyde and formaldehyde show one percent and 16 percent reduction, respectively.

Para-dichlorobenzene data show a 31 percent increase comparing periods between 1991-1993 and 2003-2005. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The ARB is exploring options to better assess the *para*-dichlorobenzene concentrations that are below its LOD.

Hexavalent chromium data show a 57 percent decrease comparing periods between 1992-1994 and 2003-2005. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. To better assess the hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

In addition to the routine monitoring, a special study was conducted at two sites, located in the Crockett and Fruitvale/Oakland areas of the San Francisco Bay Area Air Basin between October 2001 and May 2003 (Crockett) and between November 2001 and April 2003 (Fruitvale). Monitoring included both TACs and criteria air pollutants. The Crockett community is located near high-risk facilities, including mobile source emissions. Oil refineries and major oil storage facilities are located in nearby cities to Crockett. Crockett is also the location of a major food processing operation and a heavy-rail transfer facility. The Fruitvale community lies between two major freeways that are a significant source of vehicular emissions. The Fruitvale area is also downwind of several industrial operations that are sources of pollution. Although not included in this almanac, data from Crockett, Fruitvale, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

San Francisco Bay Area Air Basin

Annual Average Concentrations and Health Risks

San Francisco Bay Area Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks																	
TAC	**Conc.[1]/Risk[2]**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Acetaldehyde	Annual Avg	1.3	1.4	1.03	1.31	1.17	0.42	0.83	0.73	0.65	0.76	0.68	0.73	0.63	0.74	0.74	0.71
	Health Risk	6	7	5	6	6	2	4	4	3	4	3	4	3	4	4	3
Benzene	Annual Avg	2.18	1.82	1.49	1.49	1.4	1.26	0.71	0.61	0.71	0.6	0.56	0.425	0.454	0.439	0.372	0.314
	Health Risk	202	169	138	138	129	116	66	56	66	55	52	39	42	41	34	29
1,3-Butadiene	Annual Avg	0.359	0.287	0.275	0.367	0.287	0.277	0.218	0.187	0.217	0.17	0.149	0.133	0.137	0.098	0.09	0.075
	Health Risk	135	108	103	138	108	104	82	70	82	64	56	50	51	37	34	28
Carbon Tetrachloride	Annual Avg	0.128	0.125		0.108		0.1	0.078				0.094	0.087	0.089	0.095		
	Health Risk	34	33		29		26	21				25	23	24	25		
Chromium, Hexavalent	Annual Avg			0.23	0.2	0.19	0.25	0.13	0.12	0.1	0.1	0.12		0.074	0.096	0.091	0.082
	Health Risk			34	29	29	37	19	17	15	15	18		11	14	14	12
para-Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12			0.11	0.14	0.15	0.15	0.17	0.15
	Health Risk		8	8	8	7	8	9	8			7	9	10	10	11	10
Formaldehyde	Annual Avg	1.87	1.73	1.43	1.56	1.66	2.06	2.62	1.85	1.76	2.09	1.77	2.32	2.57	2.22	1.71	1.32
	Health Risk	14	13	11	11	12	15	19	14	13	15	13	17	19	16	13	10
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.6	0.58	0.55			0.53	0.27	0.22	0.22	0.14	0.13
	Health Risk	4	8	2	2	2	2	2	2			2	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.204	0.232	0.169	0.128	0.082	0.094	0.067	0.071			0.078	0.059	0.052	0.039	0.035	0.029
	Health Risk	8	9	7	5	3	4	3	3			3	2	2	2	1	1
Diesel PM[3]	*Annual Avg*	*(2.5)*					*(1.9)*					*(1.6)*					
	Health Risk	*(750)*					*(570)*					*(480)*					
Average Basin Risk	w/o Diesel PM	*403*	355	308	366	296	*314*	225	174	179	153	*179*	144	162	149	111	93
	w/ Diesel PM	***(1153)***					***(884)***					***(659)***					

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-44

San Joaquin Valley Air Basin
2006 Emission Inventory by Compound

Acetaldehyde

Approximately 87 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion account for approximately 10 percent.

San Joaquin Valley - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	56	3%	1%
Area-wide Sources	177	10%	2%
On-Road Mobile	731	42%	7%
Gasoline Vehicles	100	6%	1%
Diesel Vehicles	631	36%	6%
Other Mobile	797	45%	8%
Gasoline Fuel	81	5%	1%
Diesel Fuel	587	33%	6%
Other Fuel	129	7%	1%
Natural Sources	0	0%	0%
Total	1761	100%	18%
Total Statewide	10023		

Table 5-45

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 71 percent) and stationary sources (approximately 28 percent).

San Joaquin Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	502	28%	4%
Area-wide Sources	13	1%	0%
On-Road Mobile	752	42%	6%
Gasoline Vehicles	580	32%	5%
Diesel Vehicles	172	10%	1%
Other Mobile	522	29%	4%
Gasoline Fuel	308	17%	3%
Diesel Fuel	160	9%	1%
Other Fuel	54	3%	0%
Natural Sources	< 1	0%	0%
Total	1789	100%	15%
Total Statewide	12060		

Table 5-46

1,3-Butadiene

Approximately 54 percent of the emissions of 1,3-butadiene are from mobile sources.

Carbon Tetrachloride

There are no major sources of carbon tetrachloride in the San Joaquin Valley.

San Joaquin Valley - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	2	<1%	<1%
Area-wide Sources	96	19%	3%
On-Road Mobile	140	28%	4%
Gasoline Vehicles	124	25%	3%
Diesel Vehicles	16	3%	<1%
Other Mobile	134	27%	4%
Gasoline Fuel	70	14%	2%
Diesel Fuel	15	3%	<1%
Other Fuel	49	10%	1%
Natural Sources	131	26%	4%
Total	503	100%	14%
Total Statewide	**3589**		

Table 5-47

San Joaquin Valley - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0	0%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0	0%	0%
Total Statewide	**1.96**		

Table 5-48

Chromium, Hexavalent

Approximately 72 percent of the hexavalent chromium emissions are from mobile sources.

San Joaquin Valley - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.06	28%	5%
Area-wide Sources	< .01	0%	0%
On-Road Mobile	0.02	8%	1%
Gasoline Vehicles	0.02	7%	1%
Diesel Vehicles	< .01	1%	0%
Other Mobile	0.14	64%	12%
Gasoline Fuel	< .01	0%	0%
Diesel Fuel	< .01	0%	0%
Other Fuel	0.14	64%	12%
Natural Sources	0	0%	0%
Total	0.22	100%	19%
Total Statewide	**1.17**		

Table 5-49

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Joaquin Valley - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0	0%	0%
Area-wide Sources	147	100%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	147	100%	10%
Total Statewide	**1469**		

Table 5-50

Formaldehyde

Approximately 78 percent of the formaldehyde emissions are from mobile sources.

Methylene Chloride

Approximately 84 percent of the emissions of methylene chloride are from paint removers/strippers, automotive brake cleaners, and other consumer products.

San Joaquin Valley - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	756	17%	3%
Area-wide Sources	210	5%	1%
On-Road Mobile	1593	36%	7%
Gasoline Vehicles	329	7%	1%
Diesel Vehicles	1264	29%	5%
Other Mobile	1837	42%	8%
Gasoline Fuel	246	6%	1%
Diesel Fuel	1174	27%	5%
Other Fuel	418	9%	2%
Natural Sources	0	0%	0%
Total	4396	100%	19%
Total Statewide	**23154**		

Table 5-51

San Joaquin Valley - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	68	16%	1%
Area-wide Sources	361	84%	6%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	429	100%	7%
Total Statewide	**6527**		

Table 5-52

Perchloroethylene

Approximately 64 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

San Joaquin Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	375	64%	8%
Area-wide Sources	213	36%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	588	100%	12%
Total Statewide	4865		

Table 5-53

Diesel Particulate Matter

Approximately 94 percent of the diesel PM emissions are from mobile sources.

San Joaquin Valley - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	482	6%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	4584	60%	11%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	4584	60%	11%
Other Mobile	2629	34%	6%
Gasoline Fuel	0	0%	0%
Diesel Fuel	2629	34%	6%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	7695	100%	18%
Total Statewide	42326		

Table 5-54

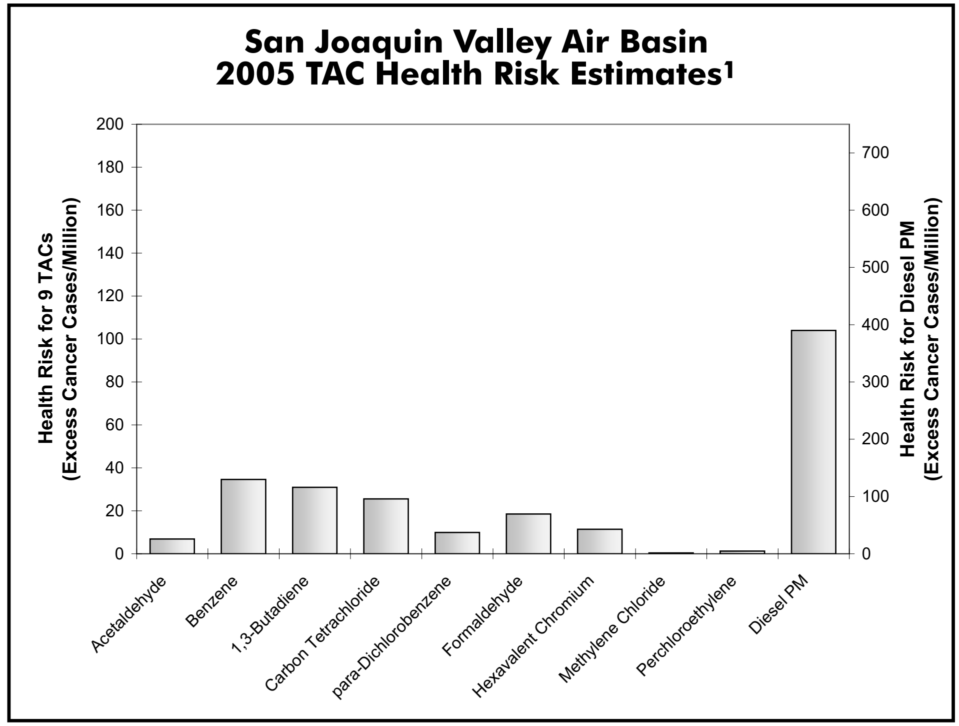
San Joaquin Valley Air Basin

Air Quality and Health Risk

From 1990 through 2005, the ARB monitored outdoor concentrations for various TACs at six sites in the San Joaquin Valley Air Basin. Data for all years are available only for the Stockton site. Data are available for 1991 through 2005 at the Fresno-First Street site, for 1990 through 1993 at the Bakersfield-Chester Avenue site, and for 1995 through 2003 at the Bakersfield-5558 California Avenue site. Data are also available at the Modesto-14th Street site from 1990 through 1999. In addition, limited TAC data are available at the Modesto-I Street site during 1991 to 1997. This almanac focuses on the top ten TACs based on available data. It is important to note that there are other compounds which pose a significant risk, but have insufficient data or are not monitored, so they are not included in the almanac.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Joaquin Valley Air Basin, are provided in Table 5-55. Data for individual sites are provided in Appendix C. Figure 5-15 shows individual health risk from the ten TACs for the San Joaquin Valley Air Basin. As indicated on the graph, the health risk data reflect the year of 2005 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used,



[1] *Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2005.*

Figure 5-15

along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the San Joaquin Air Basin, the estimated health risk from diesel PM was 390 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 50 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2003-2005. The health risks of 1,3-butadiene and benzene have been reduced by 74 percent and 80 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 81 percent and 75 percent, respectively.

Carbon tetrachloride data show a 29 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2005 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2003-2005. Acetaldehyde shows a three percent increase while formaldehyde had a nine percent decrease.

Para-dichlorobenzene data show a 29 percent increase comparing periods between 1991-1993 and 2003-2005. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The ARB is exploring options to better assess the *para*-dichlorobenzene concentrations that are below its LOD.

Hexavalent chromium data show a 62 percent decrease comparing periods between 1992-1994 and 2003-2005. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. To better assess the hexavalent chromium measurements below the LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

In addition to the routine monitoring, a special study was conducted at a site located in the Fresno area of the San Joaquin Valley Air Basin between June 2002 and August 2003. Monitoring included both TACs and criteria air pollutants. This Fresno community is located in a residential neighborhood near sources of motor vehicle pollution. There are a large number of children living in the community. Although not included in the almanac, data from Fresno and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/communities/studies/fresno/fresno.htm*.

San Joaquin Valley Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																	
TAC	**Conc.[1]/Risk[2]**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Acetaldehyde	Annual Avg	1.94	1.84	1.38	1.73	1.29	0.54	1.28	1.19	1.3	1.56	1.09	1.15	1.24	1.34	1.14	1.42
	Health Risk	9	9	7	8	6	3	6	6	6	8	5	6	6	7	6	7
Benzene	Annual Avg	2.45	2.11	1.36	1.32	1.33	1.16	0.73	0.71	0.76	0.69	0.63	0.538	0.552	0.463	0.372	0.374
	Health Risk	227	196	126	122	123	107	68	66	71	64	58	50	51	43	34	35
1,3-Butadiene	Annual Avg	0.409	0.36	0.236	0.339	0.323	0.264	0.222	0.195	0.233	0.177	0.158	0.15	0.146	0.095	0.08	0.082
	Health Risk	154	135	89	127	121	99	83	73	88	67	59	56	55	36	30	31
Carbon Tetrachloride	Annual Avg	0.128	0.129		0.109		0.098	0.077		0.114		0.096	0.086	0.091	0.097		
	Health Risk	34	34		29		26	20		30		25	23	24	26		
Chromium, Hexavalent	Annual Avg			0.23	0.21	0.19	0.28	0.13	0.11	0.1	0.1	0.12		0.086	0.078	0.083	0.076
	Health Risk			34	31	29	42	20	16	15	15	18		13	12	13	11
para-Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.1	0.13			0.11	0.13	0.15	0.15	0.15	0.15
	Health Risk		7	7	9	7	8	7	9			7	9	10	10	10	10
Formaldehyde	Annual Avg	2.45	1.81	1.46	1.67	1.8	2.1	2.96	2.77	2.86	3.44	2.61	3.08	3.13	3.02	2.27	2.52
	Health Risk	18	13	11	12	13	15	22	20	21	25	19	23	23	22	17	19
Methylene Chloride	Annual Avg	0.76	0.59	0.55	0.76	0.59	0.61	0.54	0.53	0.52	0.5	0.53	0.27	0.16	0.14	0.11	0.12
	Health Risk	3	2	2	3	2	2	2	2	2	2	2	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.126	0.133	0.104	0.473	0.067	0.068	0.068	0.056	0.039		0.076	0.052	0.039	0.033	0.027	0.032
	Health Risk	5	5	4	19	3	3	3	2	2		3	2	2	1	1	1
Diesel PM[3]	*Annual Avg*	*(2.6)*					*(1.7)*					*(1.3)*					
	Health Risk	*(780)*					*(510)*					*(390)*					
Average Basin Risk	w/o Diesel PM	*450*	401	280	360	304	*305*	231	194	235	181	*196*	169	184	157	111	114
	w/ Diesel PM	*(1230)*					*(815)*					*(586)*					

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-55

San Diego Air Basin
2006 Emission Inventory by Compound

Acetaldehyde

Approximately 92 percent of the emissions of acetaldehyde are from mobile sources.

San Diego - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	5	1%	0%
Area-wide Sources	45	8%	0%
On-Road Mobile	178	30%	2%
Gasoline Vehicles	79	13%	1%
Diesel Vehicles	98	17%	1%
Other Mobile	361	61%	4%
Gasoline Fuel	66	11%	1%
Diesel Fuel	224	38%	2%
Other Fuel	71	12%	1%
Natural Sources	0	0%	0%
Total	589	100%	6%
Total Statewide	**10023**		

Table 5-56

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 95 percent).

San Diego - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	39	5%	0%
Area-wide Sources	4	0%	0%
On-Road Mobile	488	56%	4%
Gasoline Vehicles	462	53%	4%
Diesel Vehicles	27	3%	0%
Other Mobile	338	39%	3%
Gasoline Fuel	248	29%	2%
Diesel Fuel	61	7%	1%
Other Fuel	29	3%	0%
Natural Sources	0	0%	0%
Total	869	100%	7%
Total Statewide	**12060**		

Table 5-57

1,3-Butadiene

Approximately 78 percent of the emissions of 1,3-butadiene are from mobile sources, and 22 percent from natural sources.

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

San Diego - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1	<1%	<1%
Area-wide Sources	< 1	<1%	<1%
On-Road Mobile	101	42%	3%
Gasoline Vehicles	99	41%	3%
Diesel Vehicles	3	1%	<1%
Other Mobile	87	36%	2%
Gasoline Fuel	56	23%	2%
Diesel Fuel	6	2%	<1%
Other Fuel	24	10%	1%
Natural Sources	52	22%	1%
Total	241	100%	7%
Total Statewide	**3589**		

Table 5-58

San Diego - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.09	100%	5%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.09	100%	5%
Total Statewide	**1.96**		

Table 5-59

Chromium, Hexavalent

Approximately 73 percent of the hexavalent chromium emissions are from other mobile sources. Stationary sources account for approximately 19 percent.

San Diego - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.04	19%	4%
Area-wide Sources	< .01	0%	0%
On-Road Mobile	0.02	7%	1%
Gasoline Vehicles	0.02	7%	1%
Diesel Vehicles	< .01	0%	0%
Other Mobile	0.17	73%	14%
Gasoline Fuel	< .01	0%	0%
Diesel Fuel	< .01	0%	0%
Other Fuel	0.17	73%	14%
Natural Sources	0	0%	0%
Total	0.23	100%	20%
Total Statewide	**1.17**		

Table 5-60

para-Dichlorobenzene

All of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Diego - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0	0%	0%
Area-wide Sources	122	100%	8%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	122	100%	8%
Total Statewide	**1469**		

Table 5-61

Formaldehyde

Approximately 94 percent of the formaldehyde emissions are from mobile sources.

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 82 percent of the emissions of methylene chloride.

San Diego - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	35	2%	0%
Area-wide Sources	56	4%	0%
On-Road Mobile	463	33%	2%
Gasoline Vehicles	267	19%	1%
Diesel Vehicles	197	14%	1%
Other Mobile	871	61%	4%
Gasoline Fuel	202	14%	1%
Diesel Fuel	448	31%	2%
Other Fuel	221	16%	1%
Natural Sources	0	0%	0%
Total	1426	100%	6%
Total Statewide	**23154**		

Table 5-62

San Diego - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	66	18%	1%
Area-wide Sources	301	82%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	367	100%	6%
Total Statewide	**6527**		

Table 5-63

Perchloroethylene

Approximately 58 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

San Diego - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	245	58%	5%
Area-wide Sources	177	42%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	422	100%	9%
Total Statewide	4865		

Table 5-64

Diesel Particulate Matter

Approximately 98 percent of the emissions of diesel PM are from mobile sources.

San Diego - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	32	2%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	760	36%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	760	36%	2%
Other Mobile	1291	62%	3%
Gasoline Fuel	0	0%	0%
Diesel Fuel	1291	62%	3%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2083	100%	5%
Total Statewide	42326		

Table 5-65

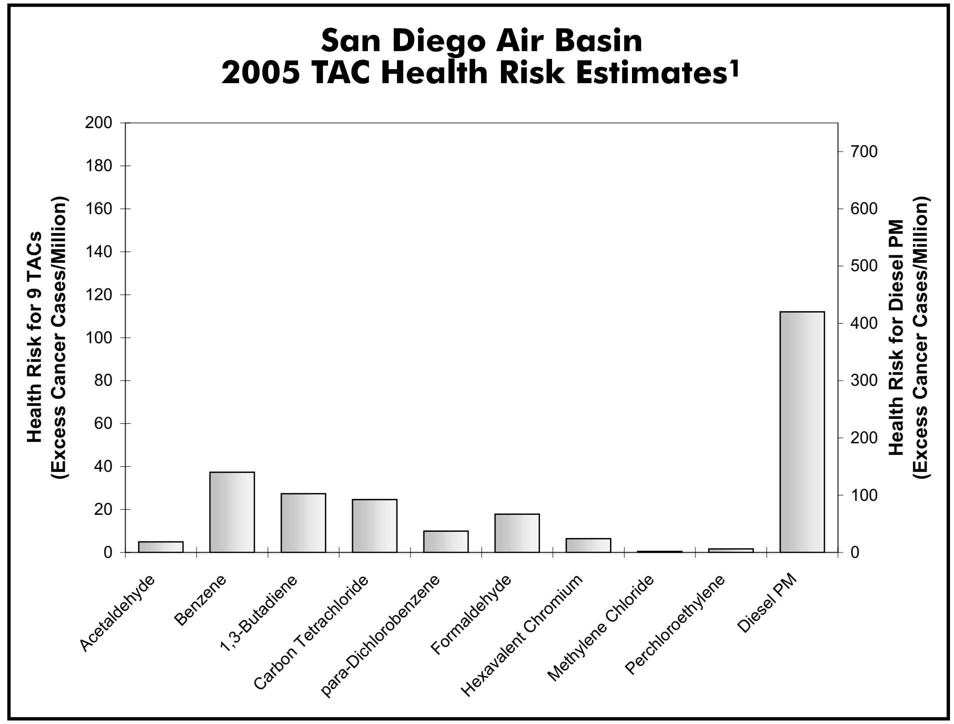
San Diego Air Basin

Air Quality and Health Risk

During 1990 through 2005, the ARB monitored outdoor concentrations for various TACs at two sites in the San Diego Air Basin. The sites are located in Chula Vista and El Cajon. This almanac focuses on the top ten TACs based on available data. It is important to note that there are other compounds which pose a significant risk, but have insufficient data or are not monitored, so they are not included in the almanac.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Diego Air Basin, are provided in Table 5-66. Data for individual sites are provided in Appendix C. Figure 5-16 shows individual health risk from the ten TACs for the San Diego Air Basin. As indicated on the graph, the health risk data reflect the year of 2005 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.



[1] *Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2005.*

Figure 5-16

Diesel PM poses the greatest health risk among the ten TACs. In the San Diego Air Basin, the estimated health risk from diesel PM was 420 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 52 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2003-2005. The health risks of 1,3-butadiene and benzene have been reduced by 72 percent and 77 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 84 percent and 85 percent, respectively.

Carbon tetrachloride data show a 30 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2005 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2003-2005. Both acetaldehyde and formaldehyde show a three percent reduction.

Para-dichlorobenzene data show a 32 percent increase comparing periods between 1991-1993 and 2003-2005. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The ARB is exploring options to better assess the *para*-dichlorobenzene concentrations that are below its LOD.

Hexavalent chromium data show a 79 percent decrease comparing periods between 1992-1994 and 2003-2005. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. To better assess hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter.

In addition to routine monitoring, a special study was conducted at a site located in the Logan Heights/Barrio Logan area of San Diego during the period of October 1999 through February 2001. Monitoring included both TACs and criteria air pollutants. The Barrio Logan community is located in a large urban area near major freeways, industrial sources, and neighborhood sources such as gas stations, dry cleaners, and automotive repair facilities. Although not included in this almanac, data from Barrio Logan and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

San Diego Air Basin
Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																	
TAC	**Conc.[1]/Risk[2]**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Acetaldehyde	Annual Avg	1.33	1.5	1.22	1.41	1.48	0.64	1.03	1	0.86	1.04	0.84	0.95	0.97	0.89	0.89	1.01
	Health Risk	6	7	6	7	7	3	5	5	4	5	4	5	5	4	4	5
Benzene	Annual Avg	2.25	1.7	1.48	1.16	1.39	0.98	0.76	0.76	0.76	0.86	0.65	0.505	0.491	0.483	0.371	0.404
	Health Risk	208	158	137	107	129	90	71	70	70	79	60	47	45	45	34	37
1,3-Butadiene	Annual Avg	0.333	0.257	0.258	0.312	0.307	0.242	0.208	0.198	0.196	0.22	0.159	0.136	0.12	0.089	0.074	0.073
	Health Risk	125	97	97	117	115	91	78	75	74	83	60	51	45	33	28	27
Carbon Tetrachloride	Annual Avg	0.132	0.127		0.103		0.099	0.077				0.094	0.086	0.092	0.093		
	Health Risk	35	34		27		26	20				25	23	24	25		
Chromium, Hexavalent	Annual Avg			0.24	0.19	0.16	0.18	0.11	0.11	0.1	0.1	0.1		0.045	0.05	0.03	0.043
	Health Risk			36	28	23	27	16	16	15	15	15		7	8	5	6
para-Dichlorobenzene	Annual Avg		0.1	0.11	0.13	0.15	0.12	0.11	0.13				0.15	0.15	0.15	0.15	0.15
	Health Risk		7	8	8	10	8	7	8				10	10	10	10	10
Formaldehyde	Annual Avg	1.64	1.53	1.26	1.76	2.25	2.13	2.62	2.62	2.27	2.67	2.23	2.59	2.99	2.68	2.19	2.42
	Health Risk	12	11	9	13	17	16	19	19	17	20	16	19	22	20	16	18
Methylene Chloride	Annual Avg	0.59	0.83	1.34	1.13	0.73	0.63	0.59	0.57		0.53	0.76	0.17	0.16	0.16	0.13	0.14
	Health Risk	2	3	5	4	3	2	2	2		2	3	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.282	0.269	0.263	0.2	0.207	0.249	0.147	0.125			0.089	0.061	0.06	0.047	0.037	0.041
	Health Risk	11	11	11	8	8	10	6	5			4	2	2	2	1	2
Diesel PM[3]	*Annual Avg*	*(2.9)*					*(1.9)*					*(1.4)*					
	Health Risk	*(870)*					*(570)*					*(420)*					
Average Basin Risk	w/o Diesel PM	*399*	328	309	319	312	*273*	224	200	180	204	*187*	157	160	147	98	105
	w/ Diesel PM	*(1269)*					*(843)*					*(607)*					

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.
2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*
3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-66

Sacramento Valley Air Basin
2006 Emission Inventory by Compound

Acetaldehyde

Approximately 69 percent of the emissions of acetaldehyde are from mobile sources. Another 29 percent are from area-wide sources, including the burning of wood in residential fireplaces and wood stoves.

Sacramento Valley - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	25	2%	0%
Area-wide Sources	302	29%	3%
On-Road Mobile	275	26%	3%
Gasoline Vehicles	74	7%	1%
Diesel Vehicles	201	19%	2%
Other Mobile	445	42%	4%
Gasoline Fuel	79	8%	1%
Diesel Fuel	320	31%	3%
Other Fuel	45	4%	0%
Natural Sources	0	0%	0%
Total	1047	100%	10%
Total Statewide	**10023**		

Table 5-67

Benzene

The primary sources of benzene emissions in the Sacramento Valley Air Basin are mobile sources (approximately 86 percent).

Sacramento Valley - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	141	14%	1%
Area-wide Sources	8	1%	0%
On-Road Mobile	493	47%	4%
Gasoline Vehicles	439	42%	4%
Diesel Vehicles	55	5%	0%
Other Mobile	397	38%	3%
Gasoline Fuel	291	28%	2%
Diesel Fuel	87	8%	1%
Other Fuel	19	2%	0%
Natural Sources	0	0%	0%
Total	1039	100%	9%
Total Statewide	**12060**		

Table 5-68

1,3-Butadiene

Approximately 51 percent of the emissions of 1,3-butadiene are from mobile sources.

Sacramento Valley - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	42	11%	1%
On-Road Mobile	98	26%	3%
Gasoline Vehicles	93	25%	3%
Diesel Vehicles	5	1%	0%
Other Mobile	92	24%	3%
Gasoline Fuel	67	18%	2%
Diesel Fuel	8	2%	0%
Other Fuel	16	4%	0%
Natural Sources	143	38%	4%
Total	376	100%	10%
Total Statewide	**3589**		

Table 5-69

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

Sacramento Valley - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.05	100%	3%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.05	100%	3%
Total Statewide	**1.96**		

Table 5-70

Chromium, Hexavalent

Approximately 66 percent of the hexavalent chromium emissions are from other mobile sources.

Sacramento Valley - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.01	31%	1%
Area-wide Sources	< .01	3%	0%
On-Road Mobile	0.01	29%	1%
Gasoline Vehicles	0.01	27%	1%
Diesel Vehicles	< .01	2%	0%
Other Mobile	0.01	37%	1%
Gasoline Fuel	< .01	0%	0%
Diesel Fuel	< .01	0%	0%
Other Fuel	0.01	36%	1%
Natural Sources	0	0%	0%
Total	0.04	100%	3%
Total Statewide	**1.17**		

Table 5-71

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

Sacramento Valley - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	105	100%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	105	100%	7%
Total Statewide	**1469**		

Table 5-72

Formaldehyde

Approximately 76 percent of the formaldehyde emissions are from mobile sources, and 16 percent are from area-wide sources.

Methylene Chloride

Approximately 70 percent of the emissions of methylene chloride are from area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products.

Sacramento Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	179	8%	1%
Area-wide Sources	341	16%	1%
On-Road Mobile	645	29%	3%
Gasoline Vehicles	243	11%	1%
Diesel Vehicles	402	18%	2%
Other Mobile	1027	47%	4%
Gasoline Fuel	243	11%	1%
Diesel Fuel	640	29%	3%
Other Fuel	144	7%	1%
Natural Sources	0	0%	0%
Total	2193	100%	9%
Total Statewide	23154		

Table 5-73

Sacramento Valley - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	108	30%	2%
Area-wide Sources	258	70%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	366	100%	6%
Total Statewide	6527		

Table 5-74

Perchloroethylene

Approximately 63 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Sacramento Valley - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	259	63%	5%
Area-wide Sources	152	37%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	410	100%	8%
Total Statewide	**4865**		

Table 5-75

Diesel Particulate Matter

Approximately 93 percent of the emissions of diesel PM are from mobile sources.

Sacramento Valley - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	218	7%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1469	46%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1469	46%	3%
Other Mobile	1472	47%	3%
Gasoline Fuel	0	0%	0%
Diesel Fuel	1472	47%	3%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	3159	100%	7%
Total Statewide	**42326**		

Table 5-76

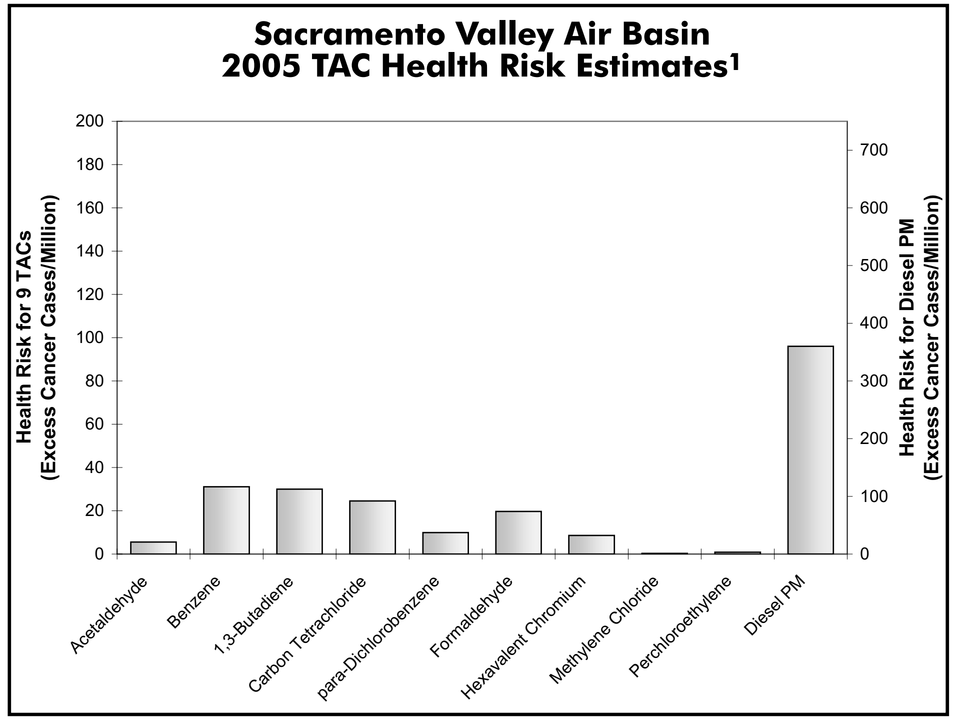
Sacramento Valley Air Basin

Air Quality and Health Risk

Unlike the other air basins described in this almanac, TAC monitoring in the Sacramento Valley Air Basin has not been continuous at any site. TAC concentrations were monitored at the Chico-Salem Street site during 1990 through the middle of 1992. The site was then moved to Chico-Manzanita Avenue. While there was monitoring in the Chico area for 1992, an annual average is not included here because neither site has a full year of data. Similarly, TAC concentrations were monitored at the Citrus Heights site during 1990 through part of 1993, when the site was relocated to Roseville. Again, annual average concentration and associated health risk are not available for the year during which the site was moved because neither site has a full year of data. This almanac focuses on the top ten TACs based on available data. It is important to note that there are other compounds which pose a significant risk, but have insufficient data or are not monitored, so they are not included in the almanac.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the Sacramento Valley Air Basin, are provided in Table 5-77. Data for individual sites are provided in Appendix C. Figure 5-17 shows individual health risk from the ten TACs for the Sacramento Valley Air Basin. As indicated on the graph, the health risk data reflect the year of 2005 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.



[1] *Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2005.*

Figure 5-17

Diesel PM poses the greatest health risk among the ten TACs. In the Sacramento Valley Air Basin, the estimated health risk from diesel PM was 360 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 52 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2003-2005. The health risks of 1,3-butadiene and benzene have been reduced by 73 percent and 78 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 87 percent and 74 percent, respectively.

Carbon tetrachloride data show a 27 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2005 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2003-2005. Both acetaldehyde and formaldehyde show a nine percent increase.

Para-dichlorobenzene data show a 10 percent increase comparing periods between 1992-1994 and 2003-2005. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The ARB is exploring options to better assess the *para*-dichlorobenzene concentrations that are below its LOD.

Hexavalent chromium data show a 60 percent decrease comparing periods between 1992-1994 and 2003-2005. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. To better assess the hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method is discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter.

Sacramento Valley Air Basin
Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																	
TAC	**Conc.[1]/Risk[2]**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23	0.83	0.74	1.14	1.04	1.09	1.15
	Health Risk	6			7	5	2	5	5	4	6	4	4	6	5	5	6
Benzene	Annual Avg	2.02	1.88	1.35	1	1.02	0.8	0.56	0.55	0.5	0.56	0.45	0.422	0.443	0.406	0.406	0.335
	Health Risk	187	174	125	92	95	74	51	51	47	52	42	39	41	38	38	31
1,3-Butadiene	Annual Avg	0.378	0.332	0.283	0.288	0.221	0.186	0.176	0.16	0.154	0.128	0.119	0.125	0.116	0.094	0.093	0.08
	Health Risk	142	125	106	108	83	70	66	60	58	48	45	47	44	35	35	30
Carbon Tetrachloride	Annual Avg	0.123	0.123		0.109		0.099	0.078				0.094	0.088	0.09	0.093		
	Health Risk	33	32		29		26	21				25	23	24	25		
Chromium, Hexavalent	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.1	0.1	0.1	0.1	0.1	0.053	0.05	0.068	0.058
	Health Risk			26	21	19	26	16	15	15	15	15	15	8	8	10	9
para-Dichlorobenzene	Annual Avg			0.11	0.1	0.2	0.14	0.11	0.14			0.1	0.13	0.15	0.15	0.15	0.15
	Health Risk			7	7	14	9	7	10			7	9	10	10	10	10
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61	2.51	2.41	3.79	3.53	2.76	2.68
	Health Risk	12			13	13	14	20	22	19	27	18	18	28	26	20	20
Methylene Chloride	Annual Avg	0.65	0.56	0.55	0.98	0.66	0.53	0.54	0.52		0.6	0.57	0.29	0.08	0.08	0.07	0.08
	Health Risk	2	2	2	3	2	2	2	2		2	2	1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.071	0.074	0.063	0.052	0.165	0.049	0.055	0.052			0.058	0.027	0.025	0.018	0.015	0.021
	Health Risk	3	3	3	2	7	2	2	2			2	1	1	<1	<1	<1
Diesel PM[3]	*Annual Avg*	*(2.5)*					*(1.6)*					*(1.2)*					
	Health Risk	*(750)*					*(480)*					*(360)*					
Average Basin Risk	w/o Diesel PM	*385*	336	269	282	238	*225*	190	167	143	150	*160*	157	162	147	118	106
	w/ Diesel PM	*(1153)*					*(705)*					*(520)*					

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.
2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*
3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-77

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